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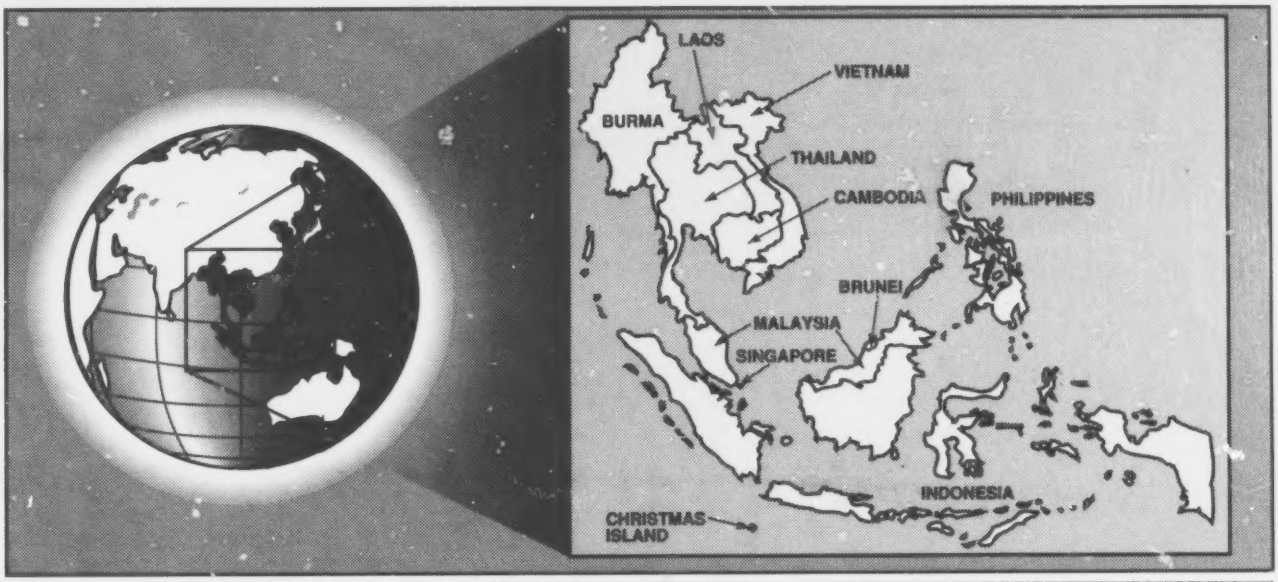

THE MINERAL INDUSTRIES OF

SOUTHEAST ASIA

By John C. Wu, Gordon L. Kinney, David B. Doan,
Travis Q. Lyday, and Chin S. Kuo

1988

INTERNATIONAL REVIEW

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

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THE MINERAL INDUSTRIES OF

SOUTHEAST ASIA

U.S.
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Secretary

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Director

1988

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THE MINERAL INDUSTRIES OF

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BRUNEI[1]

Brunei Darussalam is the official name of the 5,765-square-kilometer country that covers two wedge-shaped pieces of land, surrounded by the Malaysian State of Sarawak and the sea. It is on the northern coast of Kalimantan Island (formerly known as Borneo) and lies south of the South China Sea. Most of the country was covered with tropical rain forest, and only a narrow coastal strip was being cultivated. The population is 277,000, including 70,000 non-Malaysian residents; and 60% of the population is under 20 years of age.

The country was almost totally dependent on oil and gas production but has emerged relatively unscathed from the drop in world oil prices during the 1980's. Revenue fell from $3.1 billion[2] in 1986 to $1.0 billion in 1987. The revenues for 1988 were not available, but the gradual increase in prices coupled with lower production plans of 150,000 barrels per day (bbl/d) indicated revenues remained little changed from that of 1987.

Brunei had no national debt, trade deficit, or balance of payment problem. Furthermore, the Government was able to draw on income derived from large annual budget surpluses, which have been invested throughout the world. The standard of living was not materially affected by the oil-price fluctuations. There was no personal income tax. All health services and primary and secondary education were free. Government subsidies were available for a wide range of services, and soft loans were available for many consumer goods. Price controls were strictly observed, and inflation was low.

In July 1983, the Government set up a Brunei Investment Agency (BIA) to manage its foreign reserves as part of the process of ensuring the long-term prosperity brought about by the petroleum resources. BIA's initial $5.5-billion reserve had increased 120% (excluding new revenues) by 1987. The BIA did not publish details of investment for commercial reasons, but it was known that there was specific interest in the hotel industry.

Commodity Review

Petroleum and natural gas were the only significant minerals produced. Coal production ceased many years ago. Some gravel and cobblestone was gathered in the Temberuong area but the amount was so small that the Government has stopped keeping records.

Crude oil production was limited to 150,000 bbl/d as a long-term conservation measure. Brunei Shell Petroleum Sendirian Berhad (BSP) remained the chief operator and was the only producer of crude oil during 1988. It was

TABLE 1

BRUNEI: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Gas, natural:						
Gross[e]	million cubic feet	330,000	330,000	320,000	325,000	323,000
Marketed	do.	[e]300,000	307,645	284,565	[e]300,000	[e]298,000
Natural gas liquids:[e]						
Condensate	thousand 42-gallon barrels	5,460	5,500	5,400	5,500	5,460
Natural gasoline	do.	280	300	290	300	295
Liquefied petroleum gas	do.	115	110	100	100	95
Total	**do.**	**5,855**	**5,910**	**5,790**	**5,900**	**5,850**
Petroleum:						
Crude	do.	58,560	54,300	59,860	50,808	50,480
Refinery products:						
Gasoline	do.	605	600	[e]600	[e]650	[e]625
Distillate fuel oil	do.	395	400	[e]400	[e]450	[e]432
Residual fuel oil	do.	8	8	[e]10	[e]10	[e]9
Other including refinery fuel and losses	do.	272	300	[e]300	[e]350	[e]336
Total	**do.**	**1,280**	**1,308**	**[e]1,310**	**[e]1,460**	**[e]1,400**

[e] Estimated. [p] Preliminary.

[1] Table includes data available through Aug. 18, 1989.

[2] In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

owned by the Government of Brunei and Royal Dutch Petroleum Co. of the Netherlands. BSP operated 182 offshore structures and continued exploratory drilling in the offshore waters. It estimated that only two or three exploration wells per year would be needed to ensure that reserves of oil and gas in known fields would last 20 to 30 years at planned production rates.

One of the other companies holding exploration rights in Brunei was Elf Aquitaine Offshore BV Asia, a subsidiary of Elf Aquitaine S.A. of France. Elf spudded its first well in September and reported a flow of 2,000 barrels of oil per day and 21 million cubic feet of natural gas per day.[3]

The first phase of an ongoing development by BSP came on-line during the year. The Gannet-1 facility began producing 150 million cubic feet of gas per day and 10,000 barrels of condensate per day. The new production was delivered to the Fairley-4 offshore production complex.[4]

The production of liquefied natural gas (LNG) has become increasingly important for Brunei, the world's fourth largest producer of LNG. Natural gas produced by BSP on offshore platforms was piped to Lumut where one of the world's largest liquefaction plants was operated by Brunei LNG Sendirian Berhad, a joint venture between the Government of Brunei, Shell, and Mitsubishi Corp. of Japan. Under an exclusive 20-year contract, Brunei LNG has exported 5 million tons to Japan annually.

Transportation of the LNG required specially built tankers for the cryogenic liquid. The Government and Shell, therefore, formed a jointly owned company, Brunei Shell Tankers Co. Sendirian Berhad. It was registered in Brunei and shuttled seven tankers between Brunei and Japan on a continuous basis.

Much of the natural gas production was associated with the crude oil output. The Government was concerned that the natural gas contract would suffer when the oil production was limited to 150,000 bbl/d. They have, therefore, been concentrating on developing deposits that were either all natural gas or have the highest proportion of gas to oil. The new Gannet-1 production, which has condensate but no crude, may help keep the gas-to-crude-oil proportion at a satisfactory level. Also, the Elf discovery could eventually help increase the gas-to-oil proportion.

BURMA[5]

The Government's main objectives for the mining sector during the fifth 5-year plan were as follows: to expand mineral surveys and prospecting to increase production of crude oil, natural gas, and major raw materials for the development of heavy industry; to increase production and quality of concentrates that have the highest potential on the export market; to carry out research for the extraction of new minerals; and to emphasize those projects with the potential for the highest rate of return on investment. In addition, various incentives and amenities were to be provided workers with a view to enhancing mine productivity.[6] Toward the above goal, the Government of Burma's investment in the mining sector during fiscal year (FY) 1987[7] was $82 million[8] or 6.7% of total public investment, substantially exceeding the originally planned allotment.

Approximately 30 minerals or mineral-related commodities were produced during 1988. The most important were barite, cement, copper concentrates, crude oil, gypsum, lead, natural gas, nitrogen fertilizer, silver, steel, and concentrates of tin, tungsten, and zinc. In value, crude oil was by far the most important followed by natural gas, copper concentrates, nitrogen fertilizer, and tin metal and concentrates. The longstanding policy of not importing crude oil was reversed during 1988. The shortage of foreign exchange was surpassed by the economic problems caused by the gradual but continued decline in domestic crude oil production. None of the minerals was produced in large enough quantity to be a major factor in the world market. The usually important tin and tungsten output dropped after midyear, probably losing several places in the world output standing.

The mining industry employed about 91,000 (revised) persons during FY 1987. About 14,000 were employed by the cooperative and private sectors, the remaining were employed in State-owned mining operations. The mining sector accounted for 4.4% of total Government employees, while less than 0.1% of privately employed persons were in the mining category. Mining accounted for 1.5% of the value of the net output of goods and services at current prices. Net output value of the mining sector at constant 1969 prices was $67.7 million during FY 1987, excluding mineral fuels. This represented a nominal decline from FY 1986 levels.

Considering the political and social setting of FY 1988, the output value of the mining sector was believed to have declined substantially by yearend. The already hard-pressed economy was handed a severe setback by political turmoil and labor unrest. By September, the 25-year reign of the Chairman of the Burma Socialist Programme Party had come to an end and a military government, which had seized control, declared a "Union of Burma" dropping the words "Socialist Republic" from the country's name. In an attempt to break its international isolation and encourage badly needed foreign exchange, the new Government announced it was abandoning old rigid economic policies and welcomed foreign investment. In a statement on October 31, the Trade Minister abrogated the old trade laws by saying that a market-oriented economy will be practiced and limited liability companies and joint ventures between local and foreign private firms or with foreign governments will be permitted. Some constraints, however, were announced later. The present State monopolies

TABLE 2

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Copper:						
Mine output, Cu content		12,000	16,700	11,368	17,312	13,808
Matte, gross weight		173	173	144	234	e200
Iron and steel: Pig iron		7,764	—	r2,669	—	—
Lead:						
Mine output, Pb content		21,937	21,935	18,156	27,132	16,728
Metal:						
Refined		6,996	9,585	5,359	3,985	4,402
Antimonial lead (18% to 20% Sb)		254	e300	299	305	153
Nickel:						
Mine output, Ni content[e]		20	20	20	20	26
Speiss, gross weight		80	80	86	e80	104
Silver, mine output	thousand troy ounces	455	568	527	839	311
Tin, mine output, Sn content:						
Of tin concentrate		745	622	600	256	r102
Of tin-tungsten concentrate		1,283	1,129	895	683	427
Total		**2,028**	**1,751**	**1,495**	**839**	**529**
Metal: Refined		—	388	322	649	300
Tungsten, mine output, W content:						
Of tungsten concentrate		216	171	102	25	14
Of tin-tungsten concentrate		880	774	613	468	293
Total		**1,096**	**945**	**715**	**493**	**307**
Zinc, mine output, Zn content		5,320	4,353	4,643	2,561	2,743
INDUSTRIAL MINERALS						
Barite[3]		9,967	8,100	8,149	17,273	13,000
Cement, hydraulic		311,179	477,000	433,811	389,605	348,981
Clays:[3]						
Ball clay		960	110	496	203	203
Bentonite		725	710	851	406	508
Fire clay[4]		1,220	1,370	2,040	1,422	2,845
Industrial white clay		357	610	203	610	610
Feldspar[3]		6,220	2,446	2,861	1,916	2,626
Graphite[3]		234	234	722	—	—
Gypsum[3]		27,580	38,594	38,889	23,135	31,675
Nitrogen: N content of ammonia[5]		56,916	125,795	133,130	117,501	e125,000
Precious and semiprecious stones: Jadeite[3]	kilograms	90,990	43,145	12,804	13,529	e12,000
Salt[6]	thousand tons	280	320	321	341	249
Stone:[3]						
Dolomite		1,305	2,383	5,253	5,952	4,403
Limestone, crushed and broken	thousand tons	1,210	1,541	1,329	1,411	785
Talc and related materials: Soapstone[3]		91	128	56	22	25

See footnotes at end of table.

TABLE 2—Continued

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS						
Coal, lignite		44,232	43,000	43,848	45,700	32,514
Gas, natural:						
Gross[e]	million cubic feet	26,000	34,000	40,000	[7]42,000	44,000
Marketed[3]	do.	24,417	32,962	38,290	[7]41,284	42,350
Petroleum:						
Crude (gross wellhead)[3]	thousand 42-gallon barrels	11,200	10,253	10,103	6,351	4,612
Refinery products[e]	do.	8,000	8,000	7,500	5,800	6,000

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through June 14, 1989.

[2]In addition to the commodities listed, pottery clay, common sand, glass sand, other varieties of crude construction stone, and other varieties of gem stones are produced, but available information is inadequate to make reliable estimates of output levels.

[3]Data are for fiscal years beginning Apr. 1 of that stated.

[4]Includes fire clay powder.

[5]Computed at 46% of reported fertilizer production.

[6]Brine salt production as reported by the Burmese Government was as follows: 1984—81,166; 1985—44,508; 1986—52,084; 1987—63,700 (revised); and 1988—66,460.

[7]Reported figure.

were to be retained on some of the commodities of most interest to foreign investors including gem stones, natural gas, petroleum, and teak.

During the political upheaval, a number of important industries were closed by strikes and some were reportedly looted of equipment and supplies. The operating petroleum refineries were closed for a time as were some of the oil and natural gas production facilities. By yearend, the status of the mineral sector was far from clear. Very little information was available on industrial operations and mining in particular. Both the press and the Government were heavily preoccupied with the political situation and the worsening economic conditions.

Production

Mineral production suffered several setbacks during the year. Petroleum output continued to decline early in the year, and then came almost to a complete halt for several weeks during the height of the political and labor problems. Monthly figures through October reflected a sharp decline in lead, tin, tungsten, and zinc production. No production was reported for tin, tungsten, or silver in July and August and only nominal production of mixed tin-tungsten and zinc concentrates during the remainder of the year.

Trade

In FY 1987, the major mineral exports were concentrates of copper, tin, tungsten, and zinc; a modest amount of refined copper, lead, silver, and tin; and various colored gem stones. According to a Government publication, the provisional value of mineral and gem stones exports totaled $35.7 million.[9] The 24th Gem and Pearl Emporium (1987) accounted for $6.4 million of that total, a decrease of more than $1 million from the 1986 level. Burma began the export of high-grade chromite during 1988.

Commodity Review

***Metals.*—Chromite.**—Burma was to begin the export of metallurgical-grade chromite in September with a 5,000-ton shipment to a Japanese company. The shipment was delayed, however, until January 1989 because of the political turmoil. Ore specification was to be: 48% Cr_2O_3, Fe-Cr ratio of 1:3, and size range of 25 to 150 millimeters. The shipment was believed to represent the annual production from a recently opened mine.[10]

Gold.—In conjunction with the Burmese Ministry of Mines, the Yugoslavian Invest-Import Co. of Belgrade reportedly began construction of a gold mine near Kyauk Pahtoe (also spelled Chaukpato) in Kawlin Township 200 kilometers north of Mandalay. Under the contract, the Yugoslav company was to develop a 450,000-ton-per-year open pit, an ore flotation plant, and refining facilities. The $50 million cost was to be repaid by exports of nonferrous metal concentrates over a 6-year period. Most of the mining, concentration, and electrical equipment will be supplied by Yugoslav companies.[11]

The smelter and refinery, however, was to be designed and constructed by Davy McKee (Stockton) Ltd. under a separate contract with the Invest-Import Co. The plant was to treat 4,500 tons per year of

high-grade gold-bearing pyrite concentrate to produce 3 to 4 tons of refined gold per year.[12]

Mineral Fuels.—The production of crude oil has been declining gradually during the last decade from more than 11 million barrels in 1979 to about 6.3 million barrels in 1987. The problem was serious enough to cause a definite hardship on the already strained Burmese economy. By midyear, however, the political disruptions in the Capital and major urban centers began to exacerbate the petroleum supply problem. It was reported over the Burmese radio that the operating oil refineries had closed down, and many of the oilfield workers had also left their jobs. The disturbance in the production routine was likely to extend well beyond the settlement of the political problems. A State-run newspaper, The Guardian, stated that machinery, parts, and lubricants reportedly had been looted and sold from the Syriam refinery near Rangoon. Maintenance of industrial equipment has been a serious problem for years in Burma. These reports, if true, could mean that serious delays will be encountered in reestablishing the normal refinery output at Syriam. The Mann refinery reportedly resumed production in late October.

The Government policy had not permitted imports of crude oil for many years. The ecomonic impact of the shortages finally became so severe during FY 1988 that the policy was rescinded and the Petroleum Industries Corp. was permitted to purchase 114,000 tons of crude oil from Australia using funds from an International Development Association loan.[13]

Following years of stability, official prices of petroleum products were raised four times from September through yearend. The Government ration of 26 gallons of gasoline per month, per car, was reduced in October to 16 gallons at more than triple the former price. During the June–December period, black market prices for gasoline went from $5.30 to over $12.46 per gallon in the Rangoon area and more than $18.69 in Mandalay and outlying areas.

In an effort to increase crude oil production, the Asian Development Bank was to provide a technical assistance grant to finance a 7-month study to rehabilitate and further develop two of the major oilfields in Central Burma. It was hoped by the Government that updating present facilities and further development would increase production by 1.5 million barrels per year.[14]

CAMBODIA[15]

Events in Cambodia were dominated by the continuing political and military problems, which have plagued the country for the last two decades. The politically divergent Khmer People's National Liberation Front, National United Front for an Independent, Neutral, Peaceful and Cooperative Cambodia, and the Communist Party of Kampuchea (Khmer Rouge) were nominally united against Vietnamese troops who have occupied the capital of Phnom Penh and most of the populated agricultural areas since late 1978.[16] Until the political situation is resolved and a nationwide cease-fire is implemented, economic development on even a modest scale is going to be difficult or impossible. Mineral development was at a virtual standstill because of the security situation, a near-total lack of capital for investment, and lack of stable Government or administrative organization. The value of industrial and handicraft production reportedly increased 32% during 1988. Some 60 industrial establishments have been restored to operation. These consisted almost entirely of manual production of agricultural and textile products, the most advanced of which were a textile factory in Kompong Cham Province and a jute-bag factory in Battambang Province. A low-technology phosphate fertilizer plant at Touk Meas in Kampot Province has resumed producing phosphate fertilizer for local use. The product is phosphate rock, which is crushed, roasted, and ground to a coarse powder. No chemical treatment is performed. Nonmetallic construction materials were produced and used locally in most provinces. A small amount of salt was produced and distributed for cooking and food preservation.

A high-level Government committee was formed to survey, appraise, develop, and manage the gem stone mining sector. Its specific task was to survey the gem deposits along the western border for development and also for the ecological impact that development

TABLE 3

CAMBODIA: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
Salt	40,000	40,000	40,000	40,000	40,000

[p] Preliminary.

[1] Table includes data available through Aug. 18, 1989.

[2] In addition to the commodity listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

would have on the area. For many years, the gem stone pits have been worked haphazardly by Thais, Laotians, Burmans, and Cambodians in a strictly unofficial capacity. It has been reported that the Khmer Rouge, along the border, were selling passes to miners to permit them to cross the border from Thailand to dig for gem stones in the Phnom Pech area generally west of Battambang.[17] The old mining area near Pailin was too dangerous for work according to the refugees. Several thousand persons were reportedly involved in this mining and sold the gem stones across the border in Thailand. Forces opposed to the Phnom Penh Government claimed that Vietnamese nationals were the people mining gem stones in Samlot District of Battambang Province.[18]

Whatever the actual situation was, it was apparent that there was a considerable potential for the development of an economically significant gem stone industry in western Cambodia when political stability returns to the country.

CHRISTMAS ISLAND[19]

From 1897 until mining ceased in 1987, guano-based phosphate rock was the mainstay of the economy of the Territory of Christmas Island, an island territory of Australia in the Indian Ocean. The mining operation, owned by the Phosphate Mining Co. of Christmas Island, a wholly Australian Government-owned firm headquartered in Perth, was closed primarily due to the exhaustion of high-grade phosphate reserves. The operation was also plagued by intense labor unrest, low productivity, and diminishing profits.

TABLE 5

CHRISTMAS ISLAND: EXPORTS OF PHOSPHATE ROCK, BY DESTINATION

(Thousand metric tons)

Destination	1986	1987	1988
Australia	489.9	358.8	—
Indonesia	18.2	39.7	—
Japan	41.3	15.0	—
Korea, Republic of	22.3	9.3	—
Malaysia	196.2	253.8	—
New Zealand	107.1	164.9	—
Sri Lanka	1.1	—	—
Taiwan	3.7	5.4	—
Other	.3	—	—
Total	**880.1**	**846.9**	**—**

Source: Phosphate Rock Statistics 1987, International Fertilizer Industry Association Ltd.

INDONESIA[20]

Indonesia was the world's largest producer and exporter of LNG, the 2d largest producer of tin, the 5th largest producer of nickel, and the 14th largest producer of crude oil in 1988. Indonesia remained a significant producer of primary aluminum, bauxite, cement, coal, copper, iodine, and urea in the Far East. In line with the Government mineral policy, the mining capacity of coal, copper, gold, industrial minerals, and natural gas was expanded considerably. Because of improved world market conditions for Indonesia's exported minerals, export earnings and overall performance of the mineral industry improved.

The mineral industry continued to play a major role in the Indonesian economy in terms of contribution to gross domestic product (GDP), Gov-

TABLE 4

CHRISTMAS ISLAND: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988
Phosphate rock, marketable:						
Gross weight	thousand tons	1,259	1,187	825	842	—
P_2O_5 content	do.	443	418	288	294	—

[p] Preliminary.

[1] Table includes data available through Aug. 15, 1989.

[2] In addition to the commodity listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

ernment revenues, and export earnings. In 1988, the output quota imposed by the Organization of Petroleum Exporting Countries (OPEC) and Association of Tin Producing Countries (ATPC) continued to limit the growth of the oil and tin industries. However, improvements in the world minerals market and the Government mineral policy resulted in higher growth in the output of coal, copper, gold, industrial minerals, and natural gas. Export of minerals other than oil and tin also resulted in record earnings especially for cement, coal, copper, gold, nickel, and urea.

Despite the lower level of crude oil production due to the continuing imposition of production quotas by OPEC and other economic reasons, the output of natural gas reached a new record high. This growth was due to a 12% increase in domestic consumption by the LNG plants and two newly completed liquefied petroleum gas (LPG) plants in Aceh, North Sumatra, and in Bontang, East Kalimantan. In February, a $316 million[21] contract for building the fifth LNG train in Bontang, East Kalimantan, was awarded to Chiyoda Chemical Engineering & Construction Co. of Japan. The LNG train was expected to come on-stream and begin exporting LNG to Taiwan in 1990.

Oil and gas exploration recovered from the 1987 slump as the world oil price stabilized. The number of exploratory wells drilled rose from 82 in 1987 to 119, and 43 oil and gas wells were discovered compared with 23 in 1987. In 1988, the Government signed eight new production-sharing contracts with major oil companies from Australia, Canada, France, Japan, the Netherlands, and the United States. To step up oil and gas exploration, in August, the Government introduced tax incentives that provide tax breaks and allow a more favorable production split for exploration of high-risk smaller oilfields. To offset the declining crude oil output of aging oilfields and the lower success in discovering large oilfields, the Government announced in early 1988 that higher priority would be given to secondary recovery programs using gas-lift and water- and steam-flooding processes.

Coal production reached a record high in 1988 as the Bukit Asam Mine in South Sumatra expanded output capacity and three foreign contractors began coal mining in Kalimantan and Sumatra. Coal production was expected to increase further when two or three more foreign contractors commence mining operations in Kalimantan in 1989. Indonesia's first modern coal terminal at Tarahan on the southern tip of Sumatra was finally completed after 3 years of delay. A self-loading 10,000-ton vessel to transport coal from the terminal to the Suralaya powerplant in West Java was also inaugurated in 1988. As part of the Bukit Asam expansion program, rehabilitation of the 415-kilometer railroad system to increase coal delivery from the Bukit Asam Mine to the Tarahan Terminal was not yet completed by yearend. A feasibility study sponsored by the International Bank of Reconstruction and Development (the World Bank) for Stage II of the Ombilin coal mine expansion was completed by Norwest Resources Consultants Ltd. of the United States. Under the Government plan, negotiation of funding for the Ombilin project was expected in 1989.

In the metallic minerals sector, Indonesia achieved its targeted tin production goals and displaced Malaysia as the world's second largest tin producer. Freeport Indonesia Inc. (FI) of the United States, operating under Contract of Work with the Government at the Ertsberg area of Irian Jaya, commissioned a second underground mine and produced a record-high tonnage of copper concentrate in 1988. To raise its mining and milling capacity to 32,000 tons of ore per day by 1990, FI launched a $120 million expansion program and announced the discovery at its Grasberg prospect of a new copper deposit with 92 million tons of reserves averaging 1.43% copper plus significant values of gold and silver.

Production of nickel ore from Gebe Island and the Pomalaa area of Sulawesi by P.T. Aneka Tambang (P.T. Antam) and from the Soroako area of South Sulawesi by P.T. International Nickel (P.T. Inco) increased because of higher demand from Japan. Gold, recovered as a byproduct of copper processing by FI at the Ertsberg Mine in Irian Jaya, continued to increase because of increased mining and milling capacity. Primary gold production from alluvial deposits operated by foreign companies under Contract of Work with the Government also increased when two more contractors started mining operations in Central and West Kalimantan in late 1988. Two or three foreign contractors who had completed their feasibility studies in 1988 were expected to start gold mining in 1989.

In the industrial minerals sector, Indonesia's first chromite sand mine at the Wosu area along the East Central Coast of Sulawesi was brought on-stream by a local company, P.T. Palmabim. The chromite mining and processing facilities had an annual capacity of 40,000 tons of concentrate per year. Most finished products were exported to Australia and used as a molding media by the iron and steel casting industry. Limestone and kaolin production continued the upward trend because of increased exports to the Far East market. A feasibility study by Acorn Diamond Indonesia Pty. Ltd. was completed in 1988, and a $17.5 million diamond development project in South Kalimantan was planned for 1989–90.

In the mineral processing sector, production of primary aluminum by P.T. Indonesia Asahan Aluminum (INALUM) in North Sumatra suffered a setback from a dispute between Indonesia and its Japanese partners on output allocation. Production of nickel matte by P.T. Inco at its Soroako smelter in South Sulawesi was adversely affected by an earthquake and transformer breakdown. However, P.T. Inco improved further its financial condition

owing to higher nickel prices. In mid-1988, Inco Ltd. of Canada sold 20% of its equity in P.T. Inco to Sumitomo Metal Mining Co. Ltd. of Japan for $100 million. Inco planned to expand annual capacity of its Soroako smelter by 31% to 47,600 tons by 1990.

Because of the improved world tin market and a higher export quota provided by ATPC, production of refined tin by P.T. Tambang Timah (P.T. Timah) at Mentok on Bangka Island reached its highest level since 1981. To diversify its operations, P.T. Timah set up joint ventures in Singapore to market its tin in the world market and on Batam Island to produce tin solder. Indonesia's nitrogen fertilizer industry, supported by the Government, expanded its annual capacity of urea to 5 million tons when the third 570,000-ton-per-year urea unit was brought on-stream by P.T. Pupuk Kalimantan Timur in Bontang, East Kalimantan.

Higher growth in production and exports of nonoil commodities and increased capital investment resulted in an estimated growth of 4.2% in the Indonesian economy, as measured by the growth of GDP in 1983 constant rupiah, compared with 3.6% (revised) in 1987. Indonesia's GDP in 1983 constant dollars was estimated at $53.6 billion compared with $52.5 billion (revised) in 1987. The inflation rate, as measured by an increase in the Consumer Price Index, dropped to 7% from 8% in 1987. In 1988, Indonesia's total labor force was estimated at 72.6 million of which about 10% were unemployed.[22]

In 1988, merchandise exports rose 12% to $19.2 billion, of which 40% was exports of oil and gas. Exports of nonoil commodities increased by 34% to $11.5 billion owing to higher prices of export commodities and a 39% increase in exports of industrial products in 1988. Because of further liberalization of imports by the Government, imports also rose 9% to $13.5 billion, of which 38% was imports of machinery and transport equipment.

According to a report by the World Bank, total outstanding private and public foreign debt in 1988 was expected to reach $50 billion compared with $47.6 billion in 1987 and only $32.1 billion in 1986. Debt service payments were expected to increase 34% from that of 1987 to $9 billion. The substantial increase in Indonesia's external debt over the past 3 years was largely due to the rapid appreciation of the Japanese yen because a large portion of the country's debt was yen denominated. The report pointed out that a 6% real growth in exports of nonoil commodities is essential for Indonesia to reduce its current account deficit and meet its annual debt-service payment.[23]

Production

Despite a slight decline in output of crude oil, the oil and gas industry continued to account for more than 90% of the Indonesian mineral output value. The output of crude oil declined to a new low since 1982 because of lower OPEC quotas and other factors such as marketing difficulties. Production of natural gas rose to more than 1.8 trillion cubic feet owing to increased consumption for production and exports of LNG, LPG, and urea. Coal production rose sharply to more than 4 million tons resulting from increased capacity, stronger domestic demand by the utility and cement industries, and exports.

Production of tin recovered to a new high since 1982 because of higher prices and increased export quotas. Production of most metallic minerals was at a higher level than that of 1987 except for bauxite and primary aluminum. The continued decline in bauxite production was primarily due to reduced exports to Japan. The lower aluminum output was caused by a 2-month suspension of shipments to Japan resulting from a dispute related to redistribution of primary aluminum among partners.

The increased production of copper, gold, manganese, and nickel resulting from expanded capacity was largely attributable to higher world metal prices and stronger demand for these minerals, especially by Japan. To reduce cost of production with anticipation of continuing strong demand, production capacity of copper and nickel would be raised further in the next 2 years. As more contractors bring their gold mines on-stream, gold production capacity will also be raised in 1989. In 1988, Indonesia began production of chromite sand in Sulawesi for the first time.

To meet the growing demand for natural gas by Japan, the Republic of Korea, and Taiwan, production capacity of LPG was increased by 1.9 million tons per year in 1988, and LNG capacity will be raised by 1.5 million tons per year to 16.5 million tons per year by 1990. To meet the domestic agricultural requirement for nitrogen fertilizer material, production capacity of urea rose by 570,000 tons per year to 5 million tons per year in 1988. The Government planned to build another 570,000-ton-per-year urea plant by 1990. Indonesia's cement production rose slightly with record-high exports in 1988.

Trade

Indonesia's merchandise trade surplus improved substantially owing to a sharp increase in exports of nonoil commodities in 1988. According to the Central Bureau of Statistics, merchandise exports and imports were $19.2 billion and $13.5 billion, respectively, compared with $17.2 billion and $12.4 billion, respectively, in 1987.

Higher exports in 1988 resulted primarily from a 34% increase in exports of nonoil commodities to $11.5 billion. Industrial products accounted for $9.3 billion of these exports. Among the exports of industrial products, processed minerals such as primary aluminum, refined tin, nickel matte, cement, and fertilizer materials amounted to $1.1 billion. Exports of minerals other than crude petroleum and natural gas

TABLE 6

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	1,003	830	650	635	513
Metal, primary		198,960	216,820	218,772	201,402	185,112
Chromite sand, dry basis		—	—	—	—	7,636
Copper, mine output, Cu content		82,503	88,742	95,781	102,058	121,472
Gold, mine output, Au content[2]	troy ounces	78,677	r84,687	r102,820	114,433	152,104
Iron and steel:						
Iron sand, dry basis		82,997	130,930	153,271	193,986	202,748
Metal:						
Ferroalloys, ferronickel		22,774	23,789	22,554	8,354	24,324
Steel, crude		1,000,000	1,200,000	1,500,000	1,453,000	2,050,000
Manganese ore		12,267	r33,496	r6,612	1,855	10,278
Nickel:						
Mine output, Ni content[3]		47,604	40,336	r53,679	57,564	57,694
Metallurgical products:						
Matte: Ni content		22,815	24,946	27,975	26,508	25,179
Ferronickel: Ni content		4,826	4,802	4,548	1,683	4,905
Silver, mine output, Ag content	thousand troy ounces	r1,247	r1,232	1,498	1,623	1,979
Tin:						
Mine output, Sn content		23,223	21,759	r24,910	26,217	30,589
Metal		22,467	20,909	r22,083	24,200	28,366
INDUSTRIAL MINERALS						
Asbestos[e]		(4)	(4)	(4)	(4)	(4)
Cement, hydraulic	thousand tons	8,907	10,081	10,941	11,844	12,242
Clays:						
Bentonite		12,505	r6,111	5,730	7,171	3,791
Kaolin powder		83,414	r106,877	r132,240	112,046	139,799
Diamond:[e]						
Industrial stones	thousand carats	22	22	22	22	22
Gem	do.	5	5	6	7	7
Total	**do.**	**27**	**27**	**28**	**29**	**29**
Gypsum		712	622	532	1,367	894
Iodine	kilograms	24,970	13,416	5,790	8,227	9,753
Nitrogen: N content of ammonia		1,658,200	2,057,300	2,298,500	2,363,900	2,366,700
Phosphate rock		1,917	525	r608	2,592	411
Salt, all types	thousand tons	370	e600	e600	e600	e600
Stone:						
Dolomite		3,558	1,500	—	38,492	70,043
Granite	thousand tons	1,583	1,421	r1,422	1,181	1,122
Limestone[5]	do.	11,314	11,770	12,784	15,571	12,630
Marble	square meters	16,108	9,699	3,530	8,134	2,139
Quartz sand and silicon stone		541,827	682,125	782,620	821,563	421,126

See footnotes at end of table.

TABLE 6—Continued

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Sulfur, elemental[6]		4,999	4,023	4,525	3,941	3,411
Zeolite		—	—	—	—	626
MINERAL FUELS AND RELATED MATERIALS						
Asphalt rock, natural		471,239	450,633	242,055	84,889	—
Coal	thousand tons	1,468	1,942	2,601	2,834	4,453
Gas, natural:						
Gross	million cubic feet	1,521,450	1,580,012	r1,628,860	1,731,083	1,846,861
Marketed	do.	1,386,051	1,148,628	1,113,286	1,188,358	1,312,090
Petroleum:						
Crude including field condensate	thousand 42-gallon barrels	516,990	483,768	r507,228	479,057	491,286
Refinery products:						
Gasoline	do.	21,879	23,619	28,119	30,007	e32,000
Jet fuel	do.	4,923	3,845	1,631	3,763	e4,000
Kerosene	do.	39,141	38,383	43,043	42,207	e43,000
Distillate fuel oil	do.	43,935	50,060	73,490	77,355	e76,000
Residual fuel oil	do.	67,160	19,006	30,221	42,245	e45,000
Lubricants	do.	93	1,263	1,574	1,574	e1,600
Liquefied petroleum gas	do.	674	2,101	2,787	3,905	e4,000
Paraffin wax	do.	32	79	116	152	e150
Naphtha	do.	14,736	17,148	17,306	17,309	e17,300
Unfinished oil requiring further processing	do.	1,032	25,710	22,621	1,663	e2,000
Unspecified	do.	3,678	24,150	2,533	1,806	e3,000
Refinery fuel and losses	do.	2,251	8,527	10,004	12,790	e12,000
Total	**do.**	**199,534**	**213,891**	**233,445**	**234,776**	**e240,050**

e Estimated. p Preliminary. r Revised.

[1] Table includes data available through July 25, 1989.

[2] Includes Au content of copper ore and output by Government-controlled foreign contractors' operations. Gold output by operators of so-called People's mines and illegal small-scale mines is not available but may be as much as 15 tons per year.

[3] Includes a small amount of cobalt that is not recovered separately.

[4] Revised to zero.

[5] Data represent limestone used for cement production. Excludes considerable amounts of limestone produced by enterprises under local jurisdictions for building materials, for crushed rock to be used as aggregate, and to burn for lime.

[6] Sulfur produced by other than the Frasch process.

were $349 million, and exports of oil and gas totaled $7.7 billion. Export earnings from oil and gas were lower in 1988 because of reduced export volumes and increased consumption of crude oil by domestic oil refineries.

As a result of further liberalization of imports by the Government in 1988, total imports rose slightly to $13.5 billion of which 38% was machinery and transport equipment, 19% chemicals, 16% manufactured goods, 9% raw materials, 7% mineral fuels, and 11% other products.

To meet domestic requirements, Indonesia also imported a large amount of gypsum, phosphate rock, pyrite, and sulfur for its fertilizer and cement industries and a considerable amount of alumina, refined copper, and zinc for its metal manufacturing and fabricating industries. Other imports of minerals included asbestos, barite, bentonite, dolomite, feldspar, iron ore, kaolin, magnesite, molybdenum, and talc.

In 1988, Japan remained the largest trade partner of Indonesia and accounted for 42% of Indonesia's exports and 26% of its imports, followed by the United States accounting for 16% of

TABLE 7

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	631,763	525,811	—	All to Japan.
Oxides and hydroxides	2,803	1,669	—	Do.
Metal including alloys:				
Scrap	19	45	—	Do.
Unwrought	238,708	174,048	—	Japan 158,552; Netherlands 8,500.
Semimanufactures	534	54,138	132	Singapore 53,230.
Copper:				
Ore and concentrate	204,421	298,584	—	Japan 275,218; Republic of Korea 13,945.
Metal including alloys, all forms	405	437	—	Japan 140; Singapore 103.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	12,000	—		
Metal:				
Scrap	484	6,625	--	Japan 5,595.
Pig iron, cast iron, related materials	86,542	96,392	—	India 43,567; Japan 28,600; Malaysia 15,225.
Ferroalloys, unspecified	—	168	(2)	Mainly to Japan.
Steel, primary forms	19,921	136,101	7,640	Japan 95,616; Malaysia 22,349.
Semimanufactures:				
Bars, rods, angles, shapes, sections	94,889	88,901	38,051	China 40,582; Hong Kong 9,671.
Universals, plates, sheets	50	16,699	8,079	Japan 8,607.
Tubes, pipes, fittings	r1,000	1	—	NA.
Castings and forgings, rough	898	820	—	Singapore 554; Vietnam 266.
Unspecified	—	2	—	All to Republic of Korea.
Lead:				
Ore and concentrate	485	—		
Metal including alloys, all forms	442	122	—	Japan 53.
Manganese: Ore and concentrate[3]	30,665	4,959	—	NA.
Nickel:				
Ore and concentrate	626,745	963,198	34,950	Japan 928,248.
Matte and speiss	54,004	54,315	—	Japan 44,188; Netherlands 8,380.
Tin:				
Ore and concentrate	3,240	4,694	—	All to Malaysia.
Metal including alloys:				
Unwrought	21,104	23,804	—	Singapore 15,199; Netherlands 6,025.
Semimanufactures	50	—		
Zinc:				
Ore and concentrate	1,565	—		

See footnotes at end of table.

TABLE 7—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS—Continued				
Zinc—Continued				
Metal including alloys:				
Scrap	599	2,478	—	Japan 2,290.
Unwrought	—	150	—	All to Philippines.
Semimanufactures	10	—		
Other:				
Ores and concentrates	86,102	752	—	All to Singapore.
Ashes and residues	263	563	—	Singapore 443; Japan 120.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,802	15,650	—	Hong Kong 13,664.
Grinding and polishing wheels and stones	79	278	—	Hong Kong 247.
Barite and witherite	3,591	—		
Cement	870,931	1,699,810	—	Bangladesh 857,210; Singapore 267,180; Sri Lanka 251,342.
Clays, crude	38,116	49,029	—	Japan 11,004; Thailand 8,330; Singapore 3,090.
Fertilizer materials: Manufactured:				
Ammonia	220,250	273,370	—	Republic of Korea 79,600; Philippines 76,265; India 48,339.
Nitrogenous	684,504	1,536,826	30,000	China 400,324; Philippines 223,384; Thailand 178,113.
Phosphatic	—	120	—	NA.
Unspecified and mixed	—	4	—	All to Singapore.
Gypsum and plaster	1,839	83,935	—	Philippines 73,435; Japan 10,500.
Iodine	2	—		
Mica: Crude including splittings and waste	—	6	—	All to Singapore.
Phosphates, crude	2,200	—		
Salt and brine	—	36	—	Do.
Sodium compounds, n.e.s.: Sulfate, manufactured	4,800	—		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked thousand tons	1,115	1,306	—	Mainly to Singapore.
Worked	548	255	23	Hong Kong 122; Singapore 68.
Gravel and crushed rock	314	—		
Quartz and quartzite	20,350	36,875	—	All to Japan.
Sand other than metal-bearing thousand tons	59,284	61,693	—	All to Singapore.
MINERAL FUELS AND RELATED MATERIALS				
Coal: Anthracite and bituminous thousand tons	1,081	999	—	Japan 332; Malaysia 228; Philippines 104.
Coke and semicoke	52,401	19,804	—	Japan 11,564; Netherlands 8,229.

See footnotes at end of table

TABLE 7—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Gas, natural: Liquefied	thousand tons	15,264	[4]16,250	156	Japan 15,721.
Petroleum:					
Crude	thousand 42-gallon barrels	293,886	326,648	101,586	Japan 144,469; Singapore 26,761.
Refinery products:					
Liquefied petroleum gas	do.	6,089	NA		
Mineral jelly and wax	do.	—	([2])	—	All to Japan.
Kerosene and jet fuel	do.	444	—		
Distillate fuel oil	do.	490	1,334	—	Singapore 652; Japan 529.
Lubricants	do.	r4	15	—	Singapore 1; unspecified 14.
Residual fuel oil	do.	15,856	34,312	8,164	Japan 25,466.
Bitumen and other residues	do.	—	243	—	Netherlands 134; Japan 69.
Petroleum coke	do.	—	53	—	Netherlands 44; Malaysia 9.

r Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Includes manganiferous iron ore and concentrate.
[4] May include liquefied petroleum gas.

Indonesia's exports and 13% of imports. The total value of two-way trade between Indonesia and the United States increased slightly to $4.8 billion. The European Community (EC) countries, Malaysia, and Singapore were other important trade partners of Indonesia in 1988.

Commodity Review

***Metals.*—Aluminum and Bauxite.**—Bauxite production by P.T. Antam from the Kijang Mine on Bintan Island and other mines on nearby small islands decreased slightly from that of 1987. Exports of bauxite to Japan continued to decline as the Japanese alumina refining industry reduced its requirements, and overall exports of bauxite declined to 466,500 tons. In 1987, exports of bauxite were 583,900 tons, of which 484,000 tons went to Japan, 67,860 tons to the United States, and 32,040 tons to Venezuela. Export earnings from bauxite in 1987 and 1988 were valued at $7.3 million and $5.5 million, respectively. In 1987, Indonesia imported 265,700 tons of alumina, principally from Australia, to meet the annual requirements for its aluminum smelter at Kuala Tanjung in North Sumatra. The alumina imports in 1987 were valued at $48 million.

Production of primary aluminum by IN-ALUM's smelter at Kuala Tanjung reportedly dropped to 185,000 tons owing to power shortages caused by a lower level of water at Lake Toba where the smelter's hydroelectric powerplant is based. IN-ALUM made its first operational profit of $50 million in 1987 owing to higher prices of primary aluminum in the world market. Despite a further improvement in the world's aluminum market in 1988, exports of primary aluminum declined to 104,800 tons from 144,100 tons in 1987 mainly because of a 2-month suspension of shipments to Japan. The suspended shipments of July and August were caused by a dispute between the Government shareholders of IN-ALUM and their Japanese partners about the allocation of the smelter's output.

In July, the chairman of the Asahan Aluminum Authority ordered IN-ALUM to suspend shipments to Japan and demanded negotiations with their Japanese partners. This would reallocate the smelter's output based on a new formula that would raise Indonesia's share to 60% from one-third of the total output as originally set by the master agreement of the 1970's. The new formula proposed by Indonesia was to allocate one-third of the smelter's output for Indonesia's domestic market first, then distribute the remaining two-thirds between the two parties according to their 1987 equity shares.

In 1987, IN-ALUM underwent a

TABLE 8

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	427	2	—	Singapore 1.
Aluminum:				
Ore and concentrate	112	8	—	Netherlands 6; United Kingdom 2.
Oxides and hydroxides	225,864	303,496	210	Australia 275,678; Japan 19,308.
Metal including alloys:				
Scrap	20	8	—	Singapore 7.
Unwrought	11,987	9,551	(2)	Canada 4,115; Australia 3,937.
Semimanufactures	110,947	23,772	114	Japan 3,852; Singapore 3,782; Canada 3,355.
Arsenic: Oxides and acids	75	NA		
Beryllium: Metal including alloys, all forms	—	167	—	West Germany 94; Japan 74.
Chromium:				
Ore and concentrate	237	43	—	Mainly from Japan.
Oxides and hydroxides	180	515	147	United Kingdom 161; Japan 86.
Cobalt: Oxides and hydroxides	33	27	9	Singapore 7; Belgium-Luxembourg 5.
Copper:				
Ore and concentrate	100	—		
Matte and speiss including cement copper	16	27	8	Norway 10; Hong Kong 9.
Sulfate	314	NA		
Metal including alloys:				
Scrap	250	2,127	—	Singapore 2,027.
Unwrought	16,297	18,294	2	Zambia 7,129; Chile 4,270; Japan 4,208.
Semimanufactures	7,748	7,298	52	Japan 3,262; West Germany 1,185.
Gold: Metal including alloys, unwrought and partly wrought thousand troy ounces	11	NA		
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	132,850	754	—	Malaysia 709.
Pyrite, roasted thousand tons	1,188	1,669	—	Brazil 896; Sweden 773.
Metal:				
Scrap	190,903	475,558	91,998	Singapore 147,283; Australia 114,176.
Pig iron, cast iron, related materials	80,604	100,826	936	Malaysia 69,942; U.S.S.R. 13,500; Mozambique 11,445.
Ferroalloys:				
Ferromanganese	13,465	15,696	—	Australia 7,210; Mozambique 2,977.
Ferrosilicon	9,650	NA		
Unspecified	1,651	9,468	(3)	Mozambique 3,685; Australia 2,208; Philippines 1,020.
Steel, primary forms	43,474	93,400	49	Brazil 39,267; Australia 30,120; Belgium-Luxembourg 19,814.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures:				
Bars, rods, angles, shapes, sections	114,872	95,035	635	Japan 69,721; Republic of Korea 7,647.
Universals, plates, sheets	753,639	790,544	5,392	Japan 678,583; Republic of Korea 40,696.
Hoop and strip	9,428	7,717	5	Republic of Korea 3,611; Australia 910; Japan 841.
Rails and accessories	5,754	5,399	—	Japan 3,099; Australia 694; United Kingdom 618.
Wire	14,360	14,954	6	Japan 3,756; Republic of Korea 3,465.
Tubes, pipes, fittings	164,867	167,493	5,323	Japan 131,070; Republic of Korea 11,264.
Castings and forgings, rough	6,458	4,422	574	Japan 929; Singapore 865; Australia 318.
Lead:				
Oxides	814	1,243	—	Mexico 482; Australia 292; China 200.
Metal including alloys				
Scrap	84	161	—	Australia 60.
Unwrought	13,170	15,144	16	Australia 12,358.
Semimanufactures	—	519	20	West Germany 469.
Magnesium: Metal including alloys, all forms	116	145	18	Norway 89; Malaysia 16.
Manganese:				
Ore and concentrate	1,152	1,170	—	Singapore 1,050; United Kingdom 90.
Oxides	13,863	17,672	232	Singapore 12,302; Japan 4,468.
Mercury 76-pound flasks	1,173	5,192	—	Japan 3,133; China 1,131.
Molybdenum: Metal including alloys, all forms	1	1	—	Mainly from Netherlands.
Nickel:				
Ore and concentrate	—	1	—	All from West Germany.
Matte and speiss	—	26	—	Japan 15; Finland 10.
Metal including alloys:				
Unwrought	8	—		
Semimanufactures	1,544	59,770	74	Australia 57,759.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$20	$13	—	Austria $8; Australia $5.
Rare-earth metals including alloys, all forms	4	NA		
Silver:				
Ore and concentrate value, thousands	—	$4	$2	France $2.
Metal including alloys, unwrought and partly wrought do.	$23	$34	—	All from Japan.
Tin:				
Oxides	3	—		
Metal including alloys, all forms	103	24	3	West Germany 7; Japan 5.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Titanium: Oxides	13,787	12,749	2,427	Japan 5,044; Australia 2,362.
Tungsten:				
Ore and concentrate	—	148	—	Australia 147.
Metal including alloys, all forms	4	12	1	Netherlands 7.
Uranium and/or thorium:				
Oxides and other compounds	109	NA		
Metal including alloys, all forms	17	NA		
Vanadium: Oxides and hydroxides	24	NA		
Zinc:				
Ore and concentrate	—	4	—	All from Australia.
Oxides	747	765	16	China 237; Republic of Korea 225.
Metal including alloys:				
Scrap	495	392	—	Canada 250; Singapore 121.
Unwrought	50,612	48,558	55	Australia 40,726; Canada 3,409.
Semimanufactures	1,333	1,110	20	Republic of Korea 400; Australia 154; Singapore 120.
Other:				
Ores and concentrates	1,819	1,845	—	Malaysia 1,727.
Ashes and residues	16	32	—	Mainly from Singapore.
Base metals including alloys, all forms	117	103	—	Hong Kong 35; Japan 28; China 23.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	212	706	34	China 241; Japan 213.
Artificial:				
Corundum	19,613	167	—	Japan 165.
Silicon carbide[5]	104	NA		
Grinding and polishing wheels and stones	2,032	3,943	55	China 2,149; Japan 592.
Asbestos, crude	8,149	11,186	1,077	Canada 5,205; Mozambique 1,510.
Barite and witherite	67,536	57,959	52	Thailand 54,959.
Boron materials:				
Crude natural borates	448	17	—	All from West Germany.
Oxides and acids	1,375	300	144	France 36; United Kingdom 36.
Bromine	540	NA		
Cement	14,905	6,308	187	Thailand 1,410; Singapore 1,387.
Chalk	534	1,383	—	NA.
Clays, crude	59,079	50,617	31,114	Japan 5,140; Australia 2,990; India 2,506.
Cryolite and chiolite	2	69	—	United Kingdom 68.
Diatomite and other infusorial earth	637	769	561	Japan 177.
Feldspar, fluorspar, related materials	6,872	12,504	160	China 8,089; Japan 2,511.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials:				
Crude, n.e.s.	2,695	2,934	109	West Germany 2,745.
Manufactured:				
Ammonia	21	76	2	Japan 69.
Nitrogenous	97,200	3,349	26	Spain 2,000; West Germany 1,040.
Phosphatic	7,189	7,809	6	West Germany 5,769; Belgium-Luxembourg 1,300.
Potassic	311,674	92,123	12	Canada 71,865; Jordan 15,700.
Unspecified and mixed	13,264	30,300	304	Republic of Korea 9,854; Belgium-Luxembourg 8,800.
Graphite, natural	150	968	—	Republic of Korea 856.
Gypsum and plaster	304,939	197,530	7	Australia 105,488; Thailand 67,129.
Iodine	36	NA		
Kyanite and related materials	4	NA		
Lime	416	180	1	Singapore 139.
Magnesium compounds:				
Magnesite, crude including calcined	4,614	8,641	40	Hong Kong 3,809; China 2,190; Japan 1,209.
Oxides and hydroxides	3,153	NA		
Mica:				
Crude including splittings and waste	909	599	36	China 287; Japan 55; Singapore 46.
Worked including agglomerated splittings	107	49	9	Japan 35.
Nitrates, crude	9,265	836	—	All from Chile.
Phosphates, crude	817,431	717,572	32,525	Jordan 374,530; Morocco 201,763.
Pigments, mineral:				
Natural, crude	222	—		
Iron oxides and hydroxides, processed	4,536	4,766	2	West Germany 1,551; China 1,472.
Potassium salts, crude	—	29	—	All from Belgium-Luxembourg.
Precious and semiprecious stones other than diamond: Synthetic value, thousands	—	$6	—	All from United Kingdom.
Pyrite, unroasted	(3)	108	—	All from Republic of Korea.
Salt and brine	26,830	60,887	64	Australia 59,834.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	145,119	151,326	77,124	France 16,747; Kenya 16,350; Japan 13,791.
Sulfate, manufactured	11,229	NA		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	12,283	2,260	—	Italy 1,437; China 221; Hong Kong 186.
Worked	5,870	5,493	17	Italy 1,272; Malaysia 397.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Dolomite, chiefly refractory-grade		8,155	7,075	—	United Kingdom 3,175; West Germany 1,471.
Gravel and crushed rock		769	1,378	20	France 988; United Kingdom 166.
Limestone other than dimension		2,941	22	—	Malaysia 18; Singapore 4.
Quartz and quartzite		249	191	(3)	France 83; Sweden 56; China 20.
Sand other than metal-bearing		7,372	1,496	382	Japan 321; Singapore 161.
Sulfur:					
Elemental:					
Crude including native and byproduct		2,624	10,844	(3)	China 8,700; Republic of Korea 1,035.
Colloidal, precipitated, sublimed		182,619	221,404	50	Canada 184,432; Singapore 27,207.
Dioxide		7	NA		
Sulfuric acid		70	103	2	Singapore 83.
Talc, steatite, soapstone, pyrophyllite		13,386	27,722	141	China 19,851; Hong Kong 2,464.
Other:					
Crude		27,069	28,666	—	West Germany 21,780; East Germany 4,243.
Slag and dross, not metal-bearing		3,169	28,907	(3)	Japan 28,281.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		4,489	936	167	Singapore 350; Japan 325.
Carbon black		27,943	34,227	141	Australia 12,084; Thailand 3,826; Republic of Korea 3,140.
Coal:					
Anthracite and bituminous		15,388	335,038	54	Australia 334,737.
Briquets of anthracite and bituminous coal		29,970	—		
Lignite including briquets		475	562	264	Japan 178.
Coke and semicoke[6]		29,774	30,897	31	Japan 17,117; Australia 5,353.
Peat including briquets and litter		39	38	—	All from Singapore.
Petroleum:					
Crude	thousand 42-gallon barrels	26,739	27,837	—	All from Saudi Arabia.
Partly refined	do.	147	NA		
Refinery products:					
Liquefied petroleum gas	do.	3	(3)	(3)	Mainly from Singapore.
Gasoline	do.	126	330	—	All from Singapore.
Mineral jelly and wax	do.	86	96	(3)	China 53; West Germany 12.
Kerosene and jet fuel	do.	[7]3,000	3,378	1	Singapore 3,373.
Distillate fuel oil	do.	1,111	4,993	(3)	Singapore 4,964.
Lubricants	do.	70	389	186	Italy 70; Singapore 43.
Nonlubricating oils	do.	57	NA		
Residual fuel oil	do.	4,342	3,559	26	Singapore 3,510.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Bitumen and other residues	thousand 42-gallon barrels	1,422	1,190	(3)	Singapore 850.
Bituminous mixtures	do.	27	14	1	Singapore 8.
Petroleum coke	do.	296	303	302	NA.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Unreported quantity valued at $27,000.
[3] Less than 1/2 unit.
[4] Excludes unreported quantity valued at $62,000.
[5] Includes boron carbide.
[6] May include gas carbon.
[7] Includes 3,000 barrels of white spirit.

complicated capital restructuring program to reduce its heavy debt burden caused by the appreciation of the Japanese yen and the low price of primary aluminum in the past several years. In the process, the Government of Indonesia converted its loan into equity, the Japanese loan was refinanced with a lower interest rate and longer repayment period, and new capital was injected by the Government of Indonesia and the Japanese partners. As a result, Indonesia raised its stake to 41% from 25%, and Nippon Asahan Aluminum Co. of Japan reduced its share to 59% from 75%.

The first negotiations between Indonesian Government shareholders and their Japanese partners for reallocating the smelter's output failed in August. In September, after the two Governments agreed to conduct further talks, Indonesia's Government permitted INALUM to resume shipments to Japan. In December, officials from the Indonesian and Japanese Governments met in Jakarta to find solutions for ending the dispute. However, the issue remained unresolved at yearend.[24]

According to an Indonesian industry source, domestic demand for primary aluminum was estimated at 50,000 tons in 1988 and was expected to double in 1990 or 1991 when the $28 million aluminum casting facility is completed. The plant, to be built near IN-ALUM's smelter at Kuala Tanjung, would have an initial capacity of 35,000 tons of extrusion billets per year and 20,000 tons of foundry alloys per year. The plant will be operated by P.T. Asahan Aluminum Alloys (P.T. AAA). P.T. AAA, established in June 1987, was owned jointly by two Indonesian firms, P.T. Gesit Maju (40%) and P.T. Aluminum Development Corp. (20%), and Inter Asia Commodities Ltd. of the United Kingdom (40%).[25]

Chromite.—Indonesia completed construction of its first chromite sand mine and processing facilities in the Wosu area along the east coast of Central Sulawesi in March. The facilities were owned and operated by two Indonesian companies, P.T. Palmabim Mining and P.T. Bituminusa. The companies received technical assistance from Girond Ltd. of the United Kingdom and financial backing from Elders Resources Finance Group of Australia. The total cost of the mining and processing facilities was $3 million.

The chromite treatment plant at Wosu included a concentrator, a wood-fired rotary dryer, a high-tension electrostatic separator, and a magnetic separator. The treatment plant was capable of processing up to 500,000 cubic meters of chromite-bearing sand per year and producing 40,000 tons of chromite sand concentrate with a grading of 43% chromium oxide and less than 1% silica. Because the plant is modular, the capacity could be doubled if market conditions warrant. In 1988, production of chromite concentrate was about 7,600 tons. Most finished products, using the brand name Insulchrome, were exported to Australia for consumption by the iron casting and steel foundry industry.[26]

According to the company, chromite reserves covering a 30-kilometer coastline area around Wosu were estimated at 1 million tons, enough for a 20-year operation at an annual rate of 40,000 tons. P.T. Inco reportedly was also ex-

ploring for chromite in Sulawesi but has not yet discovered a commercially viable chromite deposit.

Copper.—Copper mining and milling operations by FI in the Ertsberg area of Irian Jaya achieved a record output of copper concentrate. The company's mining and milling capacity was expanded by 20% with opening of a new ore body in the Deep Ore Zone deposits under the Ertsberg East ore bodies in September and installation of a third primary ball mill and related flotation facilities at the mill in August.

According to the company's 1988 annual report, the ongoing expansion program for lowering the operating costs raised the mining and milling capacity to 22,000 tons of ore per day by the end of 1988 and will increase it further to 26,000 tons of ore per day by June 1989 and 32,000 tons per day by mid-1990. In 1989–90, FI planned to develop additional ore bodies at the DOM deposit using block cave mining and at the newly discovered Grasberg deposit using open pit mining. The total cost of the 3-year expansion program including development of new ore bodies, new milling facilities, and related infrastructure was estimated at $120 million.[27]

Ore processing averaged 17,054 tons per day in the first 6 months and reached 22,000 tons per day by yearend. Production of copper, gold, and silver contained in 292,000 tons of copper concentrate was 121,473 tons, 113,000 troy ounces, and 1,612,000 troy ounces, respectively. Despite the lower prices of gold and silver, FI's revenues rose to $335 million from $190 million in 1987 owing to increased exports and the higher market price of copper. The average market price of copper, gold, and silver was $1.27 per pound, $423.56 per troy ounce, and $6.32 per troy ounce, respectively, compared with $0.85 per pound, $441.73 per troy ounce, and $6.74 per troy ounce, respectively, in 1987.

As a result of ongoing exploration in its contract area, FI discovered a significant copper and gold ore body, named the Grasberg deposit, about 2.5 kilometers north of the existing Ertsberg East Mine in Irian Jaya. Following delineation drilling of 35 test holes on a 50-acre area of the 1,000-acre Grasberg prospect in 1988, FI announced that proven and probable ore reserves at Grasberg were estimated at 92 million tons of ore containing 2.9 billion pounds of copper, 4.5 million troy ounces of gold, and 7.2 million troy ounces of silver. As of December 31, 1988, FI's proven and probable ore reserves in its contract area were estimated at 185 million tons of ore containing about 6.4 billion pounds of copper, 5.8 million pounds of gold, and 27.4 million pounds of silver.[28]

After discovery of the Grasberg deposit, FI reportedly was conducting a feasibility study to expand its mill capacity to at least 50,000 tons of ore per day to handle additional ore production from the Grasberg deposit in 1990 or 1991. The result of the feasibility study was expected to be announced in the first half of 1989. FI, however, has no plans to expand its mining and milling operation downstream to copper smelting and refining.

FI was 85.39% owned by Freeport-McMoRan Copper Co. Inc., a 77%-owned subsidiary of Freeport-McMoRan Inc. of the United States; 8.95% by the Government of Indonesia; and 5.66% by Norddentsche Affineric of the Federal Republic of Germany and Fairchild Holdings Ltd. of the United States. In 1987, employees at FI's Ertsberg copper operation numbered 2,900, of which 85% were Indonesian. Exports of copper concentrate, valued at $159.2 million, totaled 250,769 tons, of which 88% went to Japan, 8% to Canada, and 4% to China in 1987.

Gold.—The overall gold production in 1988 was estimated to have reached 146,000 troy ounces, breaking the record-high level of 114,433 troy ounces (revised) in 1987. Gold that FI recovered as a byproduct from the Ertsberg copper mine at Tembagapura in Irian Jaya rose to 113,000 troy ounces from 92,000 troy ounces in 1987. Gold produced by P.T. Lusan Mining from the Lebong Tandai gold-silver mine in North Bengkulu, South Sumatra, rose to 28,000 troy ounces from 17,300 troy ounces (revised) in 1987. However, gold produced by P.T. Antam from the Cikotok gold-sliver mine in South Banten, West Java, declined to less than 5,000 troy ounces in 1988 because of the depleting ore reserves. Additionally, up to 15 tons of gold per year reportedly had been produced by small-scale people's mines and by about 150,000 illegal miners mainly in Kalimantan, Sulawesi, and Sumatra in 1987–88.[29]

Following the lifting of the gold export ban by the Government in 1986, gold exports were expected to reached a record-high level in 1988. According to the Department of Mines and Energy, exports for the first 9 months of 1988 were more than 16 tons compared with 12 tons for all of 1987. However, according to the Central Bureau of Statistics, gold exports in 1987 were 19.8 tons and were valued at $275 million. Almost all of the refined gold exports in 1987 went to Singapore, and most of the gold contained in copper concentrate went to Japan.

Among the 103 contractors exploring for gold in Indonesia, 2 went into gold production by 1988, and 1 is expected to begin production in 1989. Additionally, two other gold projects based on management contracts between Indonesian private mining companies and a foreign company were also expected to start gold production in 1989.

In late 1988, P.T. Ampalit Mas Perdana began gold production at Kasongan in the East Waringin area of Central Kalimantan. According to Pelsart Resources NL, one of the majority owners of the project, gold reserves at the mining area were estimated to have 16.4 million cubic meters of ore averaging 233 milligrams of gold per cubic meter and was expected to produce about 18,000 troy ounces of gold annu-

ally for the next 6 years beginning in 1989.

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P.T. Monterado Mas Mining reportedly was expected to begin gold production at Monterado in the Sambas area of West Kalimantan in 1989. After signing a contract of work with the Government in December 1986, the company started construction of two 400-ton-per-hour flotation plants and a concentrate upgrading plant near the mine site in 1988. The concentrate upgrading plant was expected to produce 17,000 troy ounces of doré bullion annually for 12 years starting in May 1989. According to the Department of Mines and Energy, gold reserves in the two Monterado mining areas were estimated at 66.1 million cubic meters of ore averaging 143 milligrams of gold per cubic meter and 35.9 million cubic meters of ore averaging 193 milligrams of gold per cubic meter, respectively. The gold project was a joint venture of BP Minerals International Ltd. of the United Kingdom (70%), the International Finance Corp. of Washington, DC (20%), and P.T. Prima Searco of Indonesia (10%). In June 1987, the company reportedly relinquished part of its 128,000-acre contract area in West Kalimantan.

P.T. Ara Tutu, was expected to produce gold jointly with Indo Pacific Resources NL of Australia in 1989. The company formerly had a joint-venture agreement with Abaleen Minerals NL of Australia for gold exploration in the Woyla River area of Aceh in North Sumatra in 1985. Indo Pacific Resources, had signed a Contract of Work with the Government in December 1986 under P.T. Krueng Mesen Minerals, a joint venture of Indo Pacific Resources (60%), Advocate Holding Pty. Ltd. of Australia (25%), and P.T. Aneka Aceh Subur of Indonesia (15%). The company had proven reserves of 11.5 million cubic meters of ore averaging 0.29 grams of gold per ton and 20 million cubic meters of probable reserves in the Woyla River area of Aceh in North Sumatra. Indo Pacific Resouces, which completed construction of a floating treatment plant at the Marisa alluvial deposit in North Sulawesi in 1988, is expected to start gold production in 1989.

P.T. Indo Muro Kencana, which signed a contract with the Government for gold exploration in the Barito area of Central Kalimantan in February 1985, conducted a feasibility study in 1988. Pattern drilling at the Luit and Gunung Baruh prospects in the contract area indicated 3 million tons of ore reserves averaging 7.7 grams of gold and 148 grams of silver per ton. The exploration work in the area reportedly had been impeded by about 8,500 illegal miners in 1987. P.T. Indo Muro Kencana was a joint venture involving several parties: Duval Corp.(Indonesia), a subsidiary of Pennzoil Co. of the United States (60%); Pelsart Pty. Ltd. (20%) and Jason Mining Ltd. (10%) of Australia; and P.T. Gunung Muro Perkasa (10%) of Indonesia.

P.T. Sungai Kencana, which signed a contract with the Government in February 1985 for gold exploration in the Pontianak area of West Kalimantan, let a feasibility study for the Sungai Raya alluvial prospect in March 1988. The Sungai Raya placer deposit identified in the contract area in 1987 reportedly has sufficient gold reserves with ore grade ranging from 146 milligrams of gold per cubic meter to 224 milligrams per cubic meter. P.T. Sungai Kencana was a joint venture of Duval Alluvial Mining Inc. (50%) of the United States, Pelsart Mandor Pty. Ltd. (25%) of Australia, P.T. Amsya Lyna (15%) of Indonesia, and Jimberlaya Minerals Ltd. (10%) of Hong Kong.

P.T. Prima Lirang Mining, which signed a contract with the Government in December 1986, planned to conduct a feasibility study for developing a gold and silver mine on Wetar Island in Southeast Maluku in early 1989. Exploratory drilling in 1987–88 on Wetar Island, north of East Timor, indicated ore reserves were sufficient to support a mine with an annual production of up to 600,000 tons of ore containing about 60,000 troy ounces of gold and 1.1 million troy ounces of silver. P.T. Prima Lirang Mining was originally owned by Wetar Minerals Pty. Ltd. (90%), a subsidiary of Australia's CSR Group Companies, and P.T. Prima Maluku Indah (10%) of Indonesia. In 1988, CSR sold its interest to Billiton Metals Inc. of the United States, which was a subsidiary of the Royal Dutch/Shell Group Companies of the Netherlands.

P.T. Kelian Equatorial Mining, which signed a contract with the Government for gold exploration in the Kabupaten Kutai area of East Kalimantan reportedly planned to conduct a feasibility study for developing a gold mine at the Kelian prospect in the Kabupaten Kutai area. According to an estimate by CRA Kelian Pty. Ltd., a majority owner of the project, gold reserves in the Kelian deposit have 3.7 million tons of oxide ore averaging 2.3 grams of gold per ton and 27 million tons of sulfate ore averaging 2.2 grams of gold per ton. P.T. Kelian Equatorial Mining was originally owned by CRA Kelian (90%) of Australia and P.T. Buana Jaya Raya (10%) of Indonesia. In 1986, CRA Kelian sold 9.5% of its interest to New Zealand Goldfields Investment Ltd. of the United Kingdom and 22% to Clarement Petroleum of

Australia. Clarement Petroleum then transferred its interest to Kalimantan Gold Pty. Ltd. of Australia. In 1988, CRA reportedly sold its remaining interest in the project to Billiton Metals.

As some foreign contractors moved closer to starting gold production in Indonesia, about 44 of the 103 contractors did not meet the Government's required standard of conducting a general survey within 12 months followed by a 2-year period. According to the local press, 10 Australian contractors had either defaulted on their payment of performance bonds or had poor relations with the regional authorities and with local partners. These contractors will be required by the Government to relinquish their contract area.

In July, the Ministry of Home Affairs instructed seven Provincial Governments to eliminate illegal gold mining by confiscating equipment and encouraging prospectors to work with legal miners or contractors. To ensure successful control of the illegal mining activities by the Ministry of Home Affairs, the Department of Mines and Energy temporarily stopped accepting new applications for gold exploration in the Provinces of Bengkulu, Jambi, West Kalimantan, South Kalimantan, Central Kalimantan, East Kalimantan, and North Sulawesi, effective July 9, 1988.

The Government's efforts to control illegal mining and to protect the interests of small-scale people's mines and foreign contractors reportedly resulted in some progress in 1988. For example, a joint police and army operation in Central Kalimantan reportedly has successfully driven out illegal miners from a concession area held by an Australia-United States joint-venture company. However, according to a report by the Provincial Government of Central Kalimantan in late 1988, about 4,000 of the 20,000 illegal miners deported earlier had returned to some of the more remote Contract of Work areas.

Iron and Steel.—Iron sand produced by P.T. Antam from the mining area along the eastern shore of Cilacap in Central Java reached the highest level since that of 1977. Most iron sand production was consumed by the domestic cement industry. In 1987, only 5,500 tons of iron sand was exported to Japan. The feasibility study for building an iron sand processing plant at Kulonprogo, between the village of Bugel and Yogyakarta along the south-central coast of Java, was completed by Davy McKee Corp. of the United States in 1987. The study concluded that the project was uneconomical because of high capital investment and energy costs.

Crude steel, produced mainly by state-owned P.T. Krakatau Steel, reached a new record high as both domestic demand and exports continued to expand in 1988. The 5-year modernization and expansion program to upgrade and increase steel production of Krakatau Steel's integrated facilities moved forward in 1988. According to Krakatau Steel, bids for the $550 million project by Dravo Corp. of the United States, Siemens Aktiengesellschaft of the Federal Republic of Germany, and Kawasaki Steel Corp. and Kobe Steel Ltd. of Japan were submitted. The contract was to be awarded in 1989, and construction would start in 1990. To upgrade and increase production of sponge iron and steel products and to curb imports of steel products, Krakatau's direct-reduction plant capacity would be doubled to 4 million tons per year by converting its HYL I fixed-bed process to an HYL III continuous process. The annual capacity of the slab steel plant would be expanded to 2.5 million tons, and the annual capacity of the hot strip mill and wire rod mill would be increased to 1.8 million tons and 275,000 tons, respectively.

Nickel.—Despite a short supply and higher price of nickel on the world market in 1988, overall nickel production in Indonesia remained practically at the same level as that of 1987. Nickel ore produced by P.T. Antam from the Pomalaa area in southeastern Sulawesi and on Gebe Island in the North Moluccas decreased to 1.7 million tons from 1.9 million tons in 1987. Nickel ore produced by P.T. Inco from the Soroako area in South Sulawesi rose slightly in 1988. The two producers, benefiting from exceptionally high prices of nickel and tight market conditions, reportedly made record profits in 1988 and planned to expand their production capacity beginning in 1989.[30]

Most nickel ore produced by P.T. Antam was exported to Japan, and the remainder was used to feed its own ferronickel plant in the Pomalaa area. Exports of nickel ore reportedly rose 33% to 1.6 million tons owing to increased exports to Japan. Because of higher export prices and volume, export earnings from nickel ore in 1988 were expected to exceed $39 million. According to the Department of Mines and Energy, exports of nickel ore were 1.2 million tons (revised) in 1987, of which 90% went to Japan. To create new markets, P.T. Antam exported about 80,000 tons of ore to Australia and 20,400 tons to North Korea for trial smelting in those two countries. Export earnings in 1987 were valued at $19 million.

Ferronickel produced by P.T. Antam reached a record high in 1988 owing to a sharp increase in exports to Japan and European countries. Because of heavy damage to an old furnace, the Pomalaa ferronickel plant produced only 1,683 tons of nickel contained in 8,354 tons of ferronickel ingot in 1987. Under a special 1-year agreement, about 131,300 tons of nickel ore was shipped by P.T. Antam to Japan for toll smelting by Pacific Metals Co. Ltd., which produced 1,377 tons of nickel contained in ferronickel ingot for Indonesia in 1987. Exports of ferronickel were 2,506 tons of nickel contained in 10,604 tons of ferronickel ingot and were valued at $16.8 million in 1987. Most ferronickel toll smelted by Pacific Metals reportedly had been sold to the Japanese stainless steel producers at $6 to $7 per pound in mid-1988. Exports

of ferronickel ingot reportedly rose to 4,461 tons of nickel content in 1988.

P.T. Antam, benefiting from higher export earnings of nickel in 1987–88, reported record gross profits of $28.8 million in 1988 compared with $1.8 million in 1987. In anticipation of continuing strong world demand for nickel, P.T. Antam conducted a feasibility study to double the annual capacity of its Pomalaa ferronickel plant to 10,000 tons of nickel in two stages. The cost of the expansion project was estimated at between $120 million and $150 million. The final decision for expansion would be made in 1989.

P.T. Inco, a 98% owned subsidiary of Inco Ltd. of Canada, also achieved a record-high production of nickel in matte, but the actual production was about 6,400 tons short of the planned output for 1988. The shortfall was a direct result of two factors: a 26-day production interruption in March caused by earthquake-related damage to a canal supplying water to the smelter's nearby hydroelectric powerplant and reduced capacity caused by a transformer blowout at the No. 2 furnace in December. Exports of nickel in matte totaled 28,712 tons and were valued at $299.2 million in 1988 compared with 29,603 tons and $109.2 million in 1987. Most exports were shipped to Japan for refining by Sumitomo Metal and Inco's affiliated nickel refineries in Japan, including Shimura Kako Co. Ltd. and Tokyo Nickel Co. Ltd. Because of higher nickel prices and reduced production cost, P.T. Inco made record-high operating earnings of $205 million compared with $15 million in 1987.

In July, Inco sold 20% of its equity interest in P.T. Inco to Sumitomo Metal Mining Co. Ltd. of Japan for $100 million and realized a net gain of $44.2 million. Under an agreement reached in May between the two companies, Inco was to expand the annual capacity of P.T. Inco's Soroako smelter by 31% to 47,600 tons of nickel in matte by 1990, and Sumitomo would have the right to purchase approximately 20% of the annual output from the expanded smelter. P.T. Inco reportedly started the engineering work on the expansion project in August and was expected to complete the project in mid-1990 at a cost of $80 million.[31] As of December, P.T. Inco was owned by Inco 78%, Sumitomo Metal (20.09%), and a Japanese consortium led by Mitsui & Co. and Nissho Iwai Corp. (1.91%). Proven and probable ore reserves in the Soroako area are estimated at 77.1 million tons containing 1.6 million tons of nickel.

Tin.—Indonesia displaced Malaysia as the top tin producer in Southeast Asia and became the world's second largest tin producer, accounting for 20% of the Western World production. The output of tin in concentrate was slightly more than the Government targeted level of 30,000 tons, and production of refined metal was at full capacity in 1988. Under an agreement reached by members of the ATPC in Kuala Lumpur in February, the 1988 export quota allocated to Indonesia was raised, effective March 1, 1988, until February 28, 1989, to 29,000 tons from 24,516 in 1987. Exports of refined tin reached 29,000 tons, a 30% increase from that of 1987. Indonesia reportedly was the only member, among the seven-member ATPC, meeting its export quota in 1987–88. Indonesia exported 24,241 tons of refined tin and earned $155.4 million of foreign exchange in 1987.[32]

The text table shows the tin production in Indonesia, according to the Department of Mines and Energy 1986–87, by company and area in metric tons:

Company and area	1986	1987
P.T. Tambang Timah:		
Bangka Island	12,900	12,785
Belitung Island	3,850	5,544
Singkep Island	2,900	3,306
P.T. Koba Tin:		
Bangka Island	4,682	4,042
P.T. Preussag Kelapa Kampit:		
Belitung Island	578	540
Total	**24,910**	**26,217**

P.T. Timah, the state-owned tin mining company, produced 23,919 tons of tin in concentrate, which accounted for 78% of the total tin production in 1988. However, according to the company, production costs rose by 11% to $2.87 per pound in 1988 because of higher maintenance costs and inflation. Between 1984 and 1987, P.T. Timah reduced its production costs 39% by closing some low-grade tin mines on Belitung Island and expanding production from high-grade tin deposits offshore Bangka Island. The company's work force reportedly had been reduced to 26,500 by 1987. In 1988, the company operated 13 offshore and 6 onshore suction dredges, 146 gravel pumping units, of which 16 were large scale, and 2 open pits.

P.T. Koba Tin, operated large-scale alluvial gravel pump mining and line dredging in the Koba area of Bangka Island. The company produced about 6,046 tons of tin in concentrate, which accounted for 20% of the total tin production in 1988. The company's work force was 1,550 in 1988. In April, C.S.R. Ltd. and Boral Ltd. of Australia sold their combined 75% majority interest in P.T. Koba to Renison Goldfields Consolidated Ltd. of Australia for $40 million. The remaining 25% was owned by P.T. Timah. According to P.T. Koba, ore reserves in its contract area comprised of 30,00 proven tons and an estimated total of 90,000 tons of tin.

P.T. Preussag Kelapa Kampit produced the remaining 2% or 625 tons of tin in concentrate from a partially open pit and partially underground tin mine on Belitung Island. P.T. Preussag, which took over the Contract of Work agreement with the Government from P.T. Broken Hill Pty. of Australia in 1986, was owned by Preussag AG of the Federal Republic of Germany.

In 1988, P.T. Timah took three major actions to diversify and integrate its operation. To diversify its mining operation, the company obtained a gold mining permit from the Department of Mines and Energy in February. To re-

duce the cost of marketing its refined tin, P.T. Timah established a joint-venture firm called Indonetal International Marketing Ltd. (IIM) with a private Indonesian company in December. To expand its downstream operation in tin solder production, the company set up a joint-venture firm called P.T. Asaflux Utama with a Singapore company in August. According to P.T. Timah, the company also planned to diversify into manufacturing pewter and tin oxides.

IIM reportedly was to market 50% of P.T. Timah's tin production and replace some former foreign marketing agencies and metal traders, which pulled out of the tin market after the October 1985 tin crisis. IIM, owned by P.T. Timah (20%) and P.T. Rajawali Perkasa Sejati (80%), was registered in Hong Kong and headquartered in Singapore.

P.T. Asaflux Utama completed construction of a tin solder plant on Batam Island near Singapore and started solder production in August. The plant initially produced 72 tons per month using imported lead and domestically produced tin. Most output of solder wire and bars was exported to the Far East market. P.T. Asaflux Utama was a joint venture of P.T. Timah and P.T. Asahi Solder Chemicals of Singapore.

***Industrial Minerals.*—Cement.**—Cement production rose to more than 12 million tons because of increased exports to the Far East market. The cement production in 1988 was equivalent to 70% of the industry's installed capacity in Indonesia. According to the Central Bureau of Statistics, cement exports rose to 3.1 million tons from 2.4 million tons in 1987, and export earnings from cement surged 35% to $75.6 million in 1988. In 1987, P.T. Indocement, Indonesia's largest cement producer, exported more than 1 million tons, which accounted for 60% of cement exports. Most cement exports in 1987 went to Bangladesh (46%), Sri Lanka (13%), Singapore (12%), and Mauritania (8%).

The table indicates, by company and location, Indonesia's cement production in thousand metric tons in 1986–87, according to the Department of Mines and Energy.

Company and location	1986	1987
P.T. Indocement, Cibinong, West Java	4,226	[1]4,523
P.T. Semen Padang, Indarung, West Sumatra	1,294	1,311
P.T. Semen Gresik, Gresik, East Java	1,339	1,250
P.T. Semen Cibinong, Cibinong, West Java	994	1,087
P.T. Tridaya Manungal Perkasa Cement, Cirebon, West Java	749	911
P.T. Semen Tonasa, Bantimurung, South Sulawesi	813	800
P.T. Semen Nusantara, Cilacap, Central Java	766	789
P.T. Semen Andalas Indonesia, Aceh, North Sumatra	667	688
P.T. Semen Baturaja, Baturaja, South Sumatra	424	432
P.T. Semen Kupang, Kupang, East Nusatenggara	50	53
Total	**11,322**	**11,844**

[1] Includes 7,144 tons of white cement.

Diamond.—Following completion of a feasibility study, Acorn Security Ltd. of Australia reached an agreement with the Government in August to develop Indonesia's first diamond mine in the Danau Seran area of southeastern Kalimantan. Acorn reportedly had spent $6 million through its subsidiary, Acorn Diamond Indonesia Pty. Ltd., for drilling and bulk sampling in the area for the past 2 to 3 years. The estimated cost of developing a 15-kilometer alluvial diamond mine using a rehabilitated 0.5-cubic-meter dredge and draglines was about $18 million. Acorn reportedly negotiated with several potential investors for financing the diamond development project and plans to start diamond mining in 1990 or 1991.

Under an Acorn proposal, diamond mining with an initial recovery of 423,090 carats at a rate of 0.1037 carat per cubic meter during the first 5 years of operation would generate total revenues of $86.3 million. The mining operation could be expanded later to three dredges with a total operating investment of $100 million. Estimates of ore reserves in the Danau Seran area of southeastern Kalimantan show 2.6 million cubic meters of proven diamond-bearing gravel plus 16.6 million cubic meters of probable reserves and 29.8 million cubic meters of possible reserves.[33]

Another Australian company, P.T. Pelaihari Mas Utama, signed a Contract of Work with the Government in October 1987 to explore for precious metals and diamonds in South Kalimantan. The company reportedly was near the stage of conducting a feasibility study. P.T. Pelaihari Mas Utama, a joint venture of Pelsart Pelaihari Pty. Ltd. of Australia (85%) and P.T. Indoka & Co. of Indonesia, explored for diamonds in the Banjar and Tanah Laut areas of South Kalimantan.

Fertilizer Materials.—To meet the growing domestic and overseas demand for urea and ammonium sulfate, the nitrogen fertilizer sector continued to expand its production capacity. By yearend, P.T. Pupuk Kalimantan Timor (P.T. Pupuk Kaltim) completed construction in Bontang, East Kalimantan of its third unit, Kaltim III, with a designed annual capacity of 570,000 tons of urea. Kaltim III is expected to come on-stream in February 1989. In late 1988, P.T. Pupuk Sriwijaya (P.T. PUSRI), the largest state-owned fertilizer company, began renovation of its aging PUSRI I unit built in Palembang, South Sumatra in 1963. After renovation is completed in 1990, the annual capacity of PUSRI I, which was renamed PUSRI IB, will increase to 570,000 tons from 100,000 tons. According to an industry source, the Government plans to build another urea plant with a designed annual capacity of 570,000 tons either by P.T. Pupuk Kujang or P.T. Pupuk Iskandar

Muda by 1992.

The table shows Indonesia's 1987 production and annual capacity of urea, by company and location, in thousand metric tons.

Company and location	Capacity	Production
P.T. Pupuk Sriwijaya, Palembang, South Sumatra	[1] 1,620	1,480
P.T. Pupuk Kujang, Tjikampek, West Java	570	552
P.T. Pupuk Asean-Aceh Fertilizer, Lhokseumawe, North Sumatra	570	572
P.T. Pupuk Iskandar Muda, Lhokseumawe, North Sumatra	570	589
P.T. Pupuk Kaltim, Bontang, East Kalimantan	[2] 1,140	853
Total	**4,470**	**4,046**

[1] The annual capacity will be expanded to 2,090,000 tons in 1990.

[2] The annual capacity was expanded to 1,710,000 tons in 1988.

In addition to nitrogen fertilizer, Indonesia was capable of producing about 1 million tons of triple superphosphate per year and 650,000 tons of ammonium sulfate per year. P.T. Petrokimia Gresik, which operated a large compound fertilizer complex in Gresik, East Java, was the principal producer. However, Indonesia lacks resources of potash and phosphate rock. To meet the nutritional requirements of agricultural land, Indonesia imports annually about 350,000 tons of potassium chloride and 200,000 tons of manufactured triple superphosphate from overseas.

Most raw materials required for domestic production of triple superphosphate and other compound fertilizers were also imported. Indonesia imported 1.2 million tons of phosphate rock valued at $67 million and 379,000 tons of sulfur valued at $51 million in 1987. With abundant resources of natural gas, Indonesia was able not only to meet its requirements for nitrogen fertilizer but also to export about 640,000 tons of nitrogen fertilizer to neighboring countries in the Far East in 1987.

According to an industry source, domestic demand for urea, triple superphosphate, ammonium sulfate, and potassium chloride was estimated at 3.6 million tons, 1.5 million tons, 584,000 tons, and 360,000 tons, respectively, in 1988.

***Mineral Fuels.*—Coal.**—Coal production rose sharply and reached a record-high level in 1988 because of increased output by two state-owned coal mining companies operated in West and South Sumatra by three foreign contractors, which began operation in West Sumatra and South and East Kalimantan in 1988. Exports of coal surged by 46% to 1.3 million tons, and export earnings rose 48% to $38 million in 1988.

Coal production by state-owned Perum Tambang Batubara at the Ombilin Mine in West Sumatra rose to 559,000 tons from 506,000 tons in 1987, but was still below its capacity because of mechanical problems. Coal production at Ombilin came from the Tanah Hitman open pit and the Sawan Rasau V underground operations developed under the stage 1 expansion project in 1985. A feasibility study for developing underground mines at Waringin and Northwest Sugar under the stage 2 expansion project reportedly was completed by Norwest Resources Consultants Ltd. of the United States in 1988. Stage 2 coal production with longwall mining at an annual rate of 750,000 tons was expected to begin in 1994. Financing and contracting for stage II has not yet been negotiated.[34]

Coal produced by P.T. Tambang Batubara Bukit Asam from its Air Laya open pit at Bukit Asam, South Sumatra, rose to 1.9 million tons from 1.4 million tons in 1987. An integrated part of the Bukit Asam expansion program for supplying coal to the Suralaya powerplant in West Java was construction, which reportedly was inaugurated in November, of the 2.5-million-ton-per-year Tarahan coal loading terminal near Bandar Lampung on the southern tip of Sumatra and a self-unloading 10,000-ton vessel.

Construction of the Tarahan terminal, which commenced in 1983 and was originally scheduled for completion in 1986, was delayed for 3 years because of ground instability and excessive foundation settling problems. The terminal construction, taken over from a British-Canadian consortium by Ballast Nedam BV of the Netherlands in 1987, was finally completed in November 1988.

The rehabilitation of the 450-kilometer railway linking Tanjungenim, near Bukit Asam, to the Tarahan terminal has not yet been completed. The rehabilitation project, including special reinforcement of 72 bridge abutments on the railroad, was a vital part of the expansion program to raise Bukit Asam's coal production and deliver more coal to West Java's Suralaya powerplant.

P.T. Allied Indo Coal, which signed a production-sharing contract with Perum Tambang Batubara in 1985 and commenced production in November 1987, reportedly produced 444,000 tons of good quality steam coal from its open pit at the Parambahan Mine located about 6 kilometers northeast of the Ombilin Mine in West Sumatra. About 20% of the output was delivered to Perum Tambang Batubara, and about 220,000 tons was exported to Japan, the Republic of Korea, and Taiwan. The coal mine was capable of producing 500,000 tons per year. The recoverable reserves at the mine were estimated at 12.5 million tons (0.5% sulfur, 7.1% ash, 4% inherent moisture, 37.3% volatile matter, and 51.6% fixed carbon) with an average heating value of 7,217 kilocalories.

P.T. Multi Harapan Utama, a joint venture of New Hope Indonesia Pty. Ltd. (50%) of Australia, Mr. Ibrahim Risyad (40%), and P.T. Asminco Bara Utama (20%) of Indonesia, started its open pit in the Busang area of Kutai Regency in East Kalimantan and pro-

duced 240,000 tons in 1988. The joint-venture firm, which has had a contract with the Government since December 1986, reportedly completed construction of processing and handling facilities in April at Beloro adjacent to the Mahakam River, about 25 kilometers from the mine site. The output was expected to reach 1 million tons in 1990. About 75% of the annual production would be delivered to the Suralaya powerplant. In 1988, about 103,000 tons was exported to Japan, Malaysia, and Taiwan. The measured reserves in the area were estimated at 13 million tons (0.8% sulfur, 5% ash, 11% inherent moisture, 40% volatile matter, and 44% fixed carbon) with an average heating value of 6,350 kilocalories.

P.T. Arutmin Indonesia, owned by Utah International Inc., which, in turn, was a wholly owned subsidiary of Broken Hill Pty. Ltd. of Australia, produced 105,000 tons from the Senakin Peninsula in South Kalimantan and exported most of its output to the Philippines in 1988. In 1985, about 60,000 tons was produced from the area and shipped to the Suralaya powerplant for trial burn, but the powerplant rejected it because it failed to meet specifications. The Senakin Peninsula Mine was capable of producing 1 million tons per year and had a potential to produce up to 4 million tons per year within the next 4 to 5 years.

P.T. Arutim, which signed a contract with the Government in November 1981 for coal exploration in South Kalimantan, was originally a joint venture of Utah Exploration Inc. (50%) and Atlantic Richfield Co. (50%) of the United States. In July 1986, Utah Exploration acquired the interest belonging to Atlantic Richfield. The reserves in the Senakin area were estimated at 300 million tons of subbituminous coal (0.7% sulfur, 17.3% ash, 4% inherent moisture, 40% volatile matter, and 38.7% fixed carbon) with an average heating value of 6,200 kilocalories.

Of the total production in 1988, about 1.2 million tons was produced by six major private companies with mining licenses operated mainly in East Kalimantan and South Sumatra. About 60% of the output by these private companies was exported and the remainder consumed domestically by the manufacturing sector. In the Mahakam River area of East Kalimantan, P.T. Kitadin Corp. produced 358,000 tons, P.T. Bukit Baiduri (formerly CV Baiduri Enterprise) produced 94,000 tons, P.T. Fajar Bumi Sakit produced 141,000 tons, and P.T. Tanito Harum produced 132,000 tons. In the Bengkulu area of South Sumatra, P.T. Danau Mas Hitam produced 338,000 tons, and P.T. Bukit Sunur produced 164,000 tons.

According to the Department of Mines and Energy, domestic demand for coal in 1987 was about 1.8 million tons. Major consumers included the Suralaya powerplant and the cement plants in Java and Sumatra. According to the Central Bureau of Statistics, exports of coal in 1987 were 892,600 tons: 60,500 tons was anthracite and the remainder was bituminous. The principal buyers included Japan, the Republic of Korea, Malaysia, and Taiwan. Export earnings from coal were $25.6 million.

Petroleum and Natural Gas.—Despite a stabilized world oil market, production of crude petroleum continued to decline in 1988. According to the Indonesian oil industry, the decline was the result of price and profit distortion caused by the Government pricing formula and new tax incentives, marketing difficulties, reduced output from aging oilfields, a recent slump in exploration, and fewer large exploration successes. Crude oil output, excluding condensate, averaged 1.18 million bbl/d compared with the 1988 OPEC quota of 1.19 million bbl/d. However, the output of condensate rose to an average of 165,000 bbl/d from 153,000 bbl/d in 1987.[35]

In 1988, crude petroleum was produced by state-owned PERTAMINA, 2 foreign contractors operating with Contracts of Work, and 18 foreign contractors operating with production-sharing contracts. The five leading producers were P.T. Caltex Pacific Indonesia (CPI) (39.7%), Atlantic Richfield Indonesia Inc. (10.0%), Mobil Oil Indonesia Inc. (Mobil) (8.6%), Indonesia Petroleum Ltd. (5.4%), and PERTAMINA (5.1%). The remainder was produced by 16 contractors.

Exports of crude oil and condensate dropped to 276.6 million barrels from 291.9 million barrels in 1987 because of increased consumption by domestic refineries. Export earnings from crude oil and condensate decreased to $4.1 billion from $5.0 billion (revised) in 1987. Japan and the United States remained the major buyers, together accounting for 70% of total exports. To meet requirements for domestic oil refineries, Indonesia also imported about 19.9 million barrels of crude petroleum compared with 29.2 million barrels in 1987.

Production of natural gas rose 6.6% to a new record high of an average 5 billion cubic feet per day in 1988. Increased consumption of natural gas by LNG plants remained the major contributing factor to higher natural gas production in 1988. According to Government statistics on natural gas, most of the increase in output of natural gas was attributable to increased production by the two largest producers, Mobil and Roy M. Huffington Co. (Huffco). In 1988, natural gas produced by Mobil from the Arun Gasfields in Aceh, North Sumatra, rose 8% to 858.6 billion cubic feet and accounted for 47% of the output. Production by Huffco from the Badak Gasfields in East Kalimantan rose 15% to 436.9 billion cubic feet and accounted for 24% of the output. The remainder was produced by 14 contractors and 2 state-owned oil and gas companies.[36]

The text table shows 1987–88 natural gas consumption, by end user, in billion cubic feet:

End user	1987	1988
Producers own use[1]	396.4	403.1
Flared	147.3	131.6
Utility industry	5.2	6.5
City gas industry	1.7	1.4
Nitrogen fertilizer industry	138.3	142.3
Oil refinery industry	20.9	26.3
Liquefied petroleum gas	24.5	29.2
Liquefied natural gas	917.0	1,025.0
Manufacturing industries[2]	80.8	81.5
Total	**1,732.1**	**1,846.9**

[1] For gas injection, gas lift, and fuel.
[2] Including manufacturers of cement, fertilizer materials, and steel.

In February, a $316 million contract to build the fifth 1.5-million-ton-per-year LNG train at the Badak LNG plant in East Kalimantan was signed between PERTAMINA and two Japanese companies, Chiyoda Chemical Engineering & Construction and Mitsubishi Corp. Project funding was to be provided on a nonresources basis by a Japanese consortium and a group of Japanese banks. In July, a consortium formed by Tokyo-based Indonesia Petroleum Ltd. and five Japanese trading companies reportedly was to finance 60% of the project's cost. The LNG train was scheduled to start production and begin exporting to Taiwan in early 1990. The natural gas will be supplied by the Tambora Tunu Gasfield in East Kalimantan.

Exports of natural gas in the form of LNG rose slightly to 868.6 trillion British thermal units or 149 million barrels of oil and were valued at $2.6 billion in 1988. In 1988, two LNG sales contracts were signed between PERTAMINA and Japanese buyers. The first contract, which was signed in September, was for Indonesia to supply an additional 1.45 million tons of LNG per year to Osaka Gas Co. Ltd. over the next 5.5 years. The second, which was signed in October, was to supply an additional 800,000 tons of LNG per year over the next 9.5 years to Toho Gas Co. Ltd.

In November, the President of Indonesia officially inaugurated Arun's 1.6-million-ton-per-year LPG plant and Bontang's 350,000-ton-per-year LPG plant built by JGC Corp. and Chiyoda Chemical Engineering & Construction Co. of Japan. However, the first shipment of LPG to Japan began in August following completion of phase I construction at Arun's complex in July. The total cost of the two LPG plants was $879 million, which was financed by Exports-Imports Bank of Japan (80%), a Japanese Government financial institution, and a syndicate of 23 Japanese banks and 7 Japanese insurance companies. Production and exports of LPG to Japan were planned to reach 1.95 million tons in 1989.[37]

Exports of natural gas in the form of LPG rose to 11.5 million barrels, almost double that of 1987. This increase resulted from increased exports to Japan from the two newly completed LPG plants at Arun in Aceh, North Sumatra, and in Bontang, East Kalimantan. Export earnings from LPG were valued at $89.2 million in 1988 compared with $47.9 million in 1987. Exports of LPG to Japan were made under a 10-year contract signed in July 1986 between Indonesia and seven Japanese companies led by Mitsubishi Corp. and Mitsui Liquefied Gas Corp.

Oil and gas exploration in Indonesia showed a noticeable improvement in 1988: the number of exploratory wells drilled increased to 135 from the historical low of 82 in 1987, and the number of oil and gas discoveries also increased to 43 from 23 in 1987. For exploration in the next 5 years, PERTAMINA signed eight new contracts with foreign companies compared with seven in 1987. Four of the eight contracts were based on joint operation agreements.

The four companies with JOA's in five contract areas were (1) North West Energy Ltd. of Canada in the 4,630-square-kilometer Ogan Komering block in South Sumatra, (2) Trend East Java Ltd. of the United States in the 7,391-square-kilometer Tuban block in East Java, (3) Esso Inc. of the United States in the 13,101-square-kilometer Musi-Klingi block in South Sumatra and the 81,901-square-kilometer Tuban in East Java, and (4) Shell B.V. of the Netherlands in the 57,201-square-kilometer block on Madura Island of East Java. The four other companies have production-sharing contracts. The joint venture of Total Indonesie Ltd. of France and Indonesia Petroleum Ltd. of Japan has a contract for the 1,534-square-kilometer Tengah block offshore East Kalimantan. The joint venture of Mobil Oil Corp. of the United States (60%) and Broken Hill Pty. Petroleum Inc. of Australia (40%) is in the 11,620-square-kilometer East Lengguru block in Irian Jaya and the 12,293-square-kilometer West Lengguru onshore and offshore Irian Jaya.

In February, the Government announced that Indonesia would give priority to secondary recovery programs. To tap oil reserves that are trapped in sandstone rock and cannot be extracted economically by conventional drilling, CPI began the secondary recovery program in its Duri Oilfield in late 1985. By yearend, the CPI had spent about $520 million, and the company was expected to invest $1 billion more in the next 6 to 7 years toward using the steam-flooding process to recover about 55% of Duri oil reserves. Crude oil production by steam-flooding in the Duri Oilfield was about 90,000 bbl/d in 1988.

PERTAMINA also planned to form a 50–50 joint venture with a foreign company to produce crude oil from its oilfields in the Limau area of South Sumatra using water-flooding or a gas lift process. Cost recovery in production-sharing contracts under the secondary recovery program would be limited to 65% of the contractor's share of revenue instead of 100% under the primary recovery method, and a tariff of $3 per barrel would be imposed for transporting crude oil from producing oilfields to the Plaju refinery near Palembang. Proposals submitted by six foreign companies and one Indonesian company were under consideration by PERTAMINA for contracts to be awarded in the next 5 years.[38]

LAOS[39]

Laos, with an estimated per capita income of $183[40] in 1988, was one of the poorest countries in the world, despite considerable resources of land, timber, minerals, and a large potential for hydroelectric power. The structure of production and employment was dominated by agriculture, which accounted for 65% of the GDP and provided 80% of total employment. The industrial sector was small, contributing 11.5% of the GDP, and consisted mostly of tin and gypsum mining; electricity production; small enterprises processing local raw materials, particularly food and wood; and consumer goods industries serving Vientiane, the capital city.

Against a declining economy and 53% inflation rate in 1983–85, the Government initiated a program of reforms in 1985 known as the New System of Economic Management. The program, expanded and modified in 1987 and 1988, extended autonomy to state enterprises and eased Government restrictions on trade and prices. Government subsidies were lowered or eliminated. The reforms were broadened further by allowing all forms of enterprises, including private companies and joint ventures, and stimulating competition among the various economic sectors.

Indications in late 1988 were that the reforms were showing positive results. Inflation dropped to 10%; exports, other than electricity, rose 36% from that of 1986; and several joint-venture enterprises were formed, mostly with Thai investors.

The impact of the reforms on growth and the balance of payments was partly masked by a persistent drought. Food production was lower and electricity output was halved in 1988. Despite the decline in these important economic weathervanes, 1988 real GDP was estimated to have increased 2%, reflecting the stronger nonagricultural activity.

Deposits of coal, gypsum, iron ore, potash, salt, and tin have been identified, but only gypsum and tin have been exploited in economically significant amounts. The Government has been encouraging the expansion of the modest tin industry in order to increase the foreign exchange earnings that the tin industry has generated. A 108-kilometer-long 22-kilovolt powerline was under construction from Thakhek to the Phon Tiou Mine. By the end of 1988, the plan called for 46 kilometers to be completed. Reliable power should be available for the first time at the mine during 1990. Construction was somewhat behind schedule because of a lack of funding and an inadequate supply of construction materials and transmission equipment. Several countries were looking into the possibility of investing in the industrial sector of Laos as a result of recent economic policy changes. Tin was one of those specifically mentioned as having good investment potential.

In order to further increase tin output without the expenditure of scarce capital, the Government has begun to encourage cottage-industry tin production. Placer tin was being panned or manually sluiced by families in the Hinboun District of Khammouan Province. All three of the Government-owned tin operations, Phon Tiou, Bo Neng, and Nong Seun, purchased panned concentrate from the villagers. About 10 tons of +51% Sn concentrate was purchased per month by these Government operations in the latter part of 1988.

Development of the potash resources of the Vientiane Basin could become a reality if the Foreign Trade Department of Laos has its way. Representatives of the department reportedly have asked Australia and India to look into the possibility of commercial exploitation. According to a World Bank report, the potash resources on the Laos side of the Mekong River contained a higher proportion of the mineral sylvite (KCl), and the Thailand-side deposits were believed to contain more of the less valuable carnalite. A Vietnamese geological group was exploring the deposits that have not been explored in detail. Published estimates of reserves appear to be widely exaggerated or based on erroneous assumptions. A

TABLE 9

LAOS: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
Cement (from imported clinker)	—	[3]2,500	4,000	4,500	4,500
Gypsum	[3]82,000	110,000	130,000	70,000	[3]80,000
Salt, rock	[3]8,000	10,000	30,000	13,000	30,000
Tin, mine output, Sn content	430	[3]540	550	450	[3]300

[p] Preliminary.

[1] Table includes data available through Aug. 18, 1989.

[2] In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3] Reported figure.

TABLE 10

LAOS: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal destinations, 1987
Aluminum: Metal including alloys, scrap	69	926	All to Thailand.
Copper: Metal including alloys, scrap	10	398	Do.
Diamond: Gem, not set or strung value, thousands	—	$1	All to Cyprus.
Gypsum and plaster	—	682	All to Jordan.
Iron and steel: Metal: Scrap	—	408	All to Thailand.
Salt and brine	—	7,818	All to United States.
Stone, sand and gravel:			
Dimension stone: Crude	—	32	All to Jordan.
Limestone	—	13,805	All to United States.
Other: Base metals including alloys, all forms value, thousands	—	$33	Do.

[p] Preliminary.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Laos, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries.

figure of 50 billion tons referred to in several sources was apparently derived by extrapolating data from a few widely spaced drill holes on the Thai side of the Mekong River. Until detailed information is available from either Vietnamese geologists or other qualified experts, it would not be possible to plan any specific exploitation of the potash. Laos should be able to supply low-cost electricity for mineral processing because it exported a large amount of power to Thailand in order to earn foreign exchange.

Thailand signed an initial agreement to supply refined petroleum products to Laos. The $13 million agreement was a direct result of the Thai Prime Minister's attempt to normalize trade relations with Laos. Thailand previously classified petroleum as a strategic product and banned exports to Laos.

In an additional agreement, a French trading company signed a contract with

TABLE 11

LAOS: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS			
Aluminum: Metal including alloys, all forms	3	[2]18	Switzerland 12; Thailand 6.
Copper: Metal including alloys, all forms	1	1	All from Thailand.
Iron and steel: Metal:			
Ferroalloys	1	—	
Steel, primary forms	2	—	
Semimanufactures:			
Bars, rods, angles, shapes, sections	896	924	Thailand 834; Japan 90.
Universals, plates, sheets	5,138	120	Japan 62; Thailand 58.
Wire	493	50	Thailand 49; Italy 1.
Tubes, pipes, fittings	586	227	Thailand 220; Japan 7.
Lead: Metal including alloys, all forms	([3])	2	All from Thailand.
Nickel: Metal including alloys, all forms value, thousands	—	$1	Do.
Silver: Metal including alloys, unwrought and partly wrought do.	$1	$1	Do.
Tin: Oxides	3	—	

See footnotes at end of table.

TABLE 11—Continued

LAOS: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
METALS—Continued				
Zinc:				
Ore and concentrate		—	630	All from Thailand.
Oxides		—	1	Do.
Metal including alloys, semimanufactures		750	957	Do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones		2	8	Do.
Cement		10,350	18,060	Do.
Fertilizer materials: Manufactured:				
Ammonia		5	1	Do.
Nitrogenous		1,910	447	Japan 377; Thailand 70.
Unspecified and mixed		250	[4]558	Japan 550.
Potassium salts, crude		—	34,507	All from Jordan.
Salt and brine		97	146	All from Thailand.
Sodium compounds, n.e.s.: Carbonate, natural and manufactured		27	—	
Stone, sand and gravel:				
Dimension stone: Worked		13	[5]51	Do.
Limestone other than dimension		—	24	Do.
Sand other than metal-bearing		8	3	Do.
Sulfur:				
Elemental: Colloidal, precipitated, sublimed		3	3	Do.
Sulfuric acid		18	8	Do.
Talc, steatite, soapstone, pyrophyllite		63	—	
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		2	—	
Coke and semicoke		3	3	Do.
Petroleum refinery products:				
Liquefied petroleum gas	42-gallon barrels	12	—	
Lubricants	do.	56	[6]14	Do.

[p] Preliminary.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Laos, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Laos during 1987.

[2] Excludes unreported quantity valued at $4,000 exported by Japan.

[3] Unreported quantity valued at $1,000 exported by Thailand.

[4] Excludes unreported quantity valued at $18,000 exported by Thailand.

[5] Excludes unreported quantity valued at $2,000 exported by United States.

[6] Excludes unreported quantity valued at $17,000 exported by Japan.

the Lao Government in September to supply 7,000 to 8,000 barrels per month of petroleum products. Shipments were to begin in March 1989.

The Vietnamese have also been helping with the development of the Lao infrastructure system. They have nearly completed a fuel depot in Pak District in the remote northwest Province of Oudomsai. The depot was believed to contain 10 tanks with a capacity of 1,572 barrels each.

Along with the petroleum agreement, Laos and Thailand were also consulting on setting up a joint-venture

company to explore for and mine anthracite and other minerals in Laos. The proposal was initiated by the Lao Ministry of Commerce and Foreign Economic Relations. Lao workers reported a possible reserve of 4 million tons of high-grade anthracite 115 kilometers northwest of Vientiane.

The Asian Development Bank approved an $11 million concessional loan to the Lao Government for a 208-kilometer, 115-kilovolt, single-circuit power transmission line. The line would run from the Nam Ngum hydroelectric power station through Vang Vieng to the ancient, former capital city of Luang Prabang. The line is to bring continuous reliable power for the first time to its service area and, in particular, supply a planned cement plant in Vang Vieng.[41]

MALAYSIA[42]

The mineral industry remained an important sector of the Malaysian economy mainly because of its significant contribution to Government revenues, export earnings, and economic growth. After the decline of the tin industry in 1985, the oil and gas industry became the only driving force for the growth of the Malaysian mineral industry. The 8% growth in the mineral industry in 1988 was simply a reflection of increased output of the oil and gas industry. The tin industry, which was still adhering to the production restrictions of the ATPC, was unable to maintain its position as the world's largest tin supplier. Nevertheless, the financial condition of the oil and tin industries in Malaysia improved considerably when the world prices of oil and tin moved higher in 1988.

In line with the Government policy to develop the vast resources of oil and gas to increase Malaysia's export earnings, to generate revenues for the major industrial projects, and to support the expansion of the manufacturing sector under the Fifth Malaysia Plan (1986–90), the oil and gas industry began expansion of its production capacity in the oilfields and gasfields off Terengganu in the South China Sea. In 1988, Malaysia became a coal-producing country again when a new surface coal mine was opened.

The first-stage development of the Seligi Oilfield, Malaysia's largest, was completed in December by Esso Production Malaysia Inc. (EPMI). EPMI and Petronas Carigali Pty. Ltd. were also jointly developing the Dulang Oilfield in the South China Sea. Malaysia's crude petroleum production capacity would be raised by 180,000 bbl/d to 760,000 bbl/d when the seven-platform Seligi Oilfield and the Dulang Oilfield come on-stream in late 1990.

Substantial progress was made in the second phase of the project to bring natural gas from offshore Terengganu to southern Johore and Singapore, and to the industrial and population centers in western Peninsular Malaysia. In mid-1988, Malaysia agreed to supply at least 150 million cubic feet per day of natural gas to Singapore for 15 years starting in 1990. Under a separate agreement, the Japanese Government was to extend a $330 million[43] low-interest loan to Malaysia for construction of the 730-kilometer pipeline system. By yearend, the Government had chosen MMC Gas Sdn. Bhd. to lay the pipelines.

Malaysia signed 10 new production-sharing contracts compared with 7 (revised) in 1987 for oil and gas exploration offshore Peninsular Malaysia, Sabah, and Sarawak. Increased oil discoveries on the Indonesian side of the Strait of Malacca have resulted in renewed interest in oil exploration on the Malaysian side of the strait. Malaysia has 2.8 billion barrels of oil reserves, 42 trillion to 43 trillion cubic feet of nonassociated gas, and 9 trillion to 10 trillion cubic feet of associated natural gas.[44]

Performance of the metallic mining sector was disappointing, particularly in the production of bauxite, copper, and tin, which all moved lower despite improvement in the world's metal market. However, production of ilmenite and zircon continued to rise. To revive the metallic mining activity, especially in tin mining, the Government announced in March that it was working with the United Nations Development Program to draft a national mineral policy that would provide financial incentives to the mineral industry. The national mineral policy, which was expected to cover investment, production cost, mineral ownership and corporate taxes on tin and other hard-rock mining, was to be finalized in 1989.

Production of sponge iron, LNG, and nitrogen fertilizer materials were at full capacity. A plan to build a 115,000-ton-per-year aluminum smelter was still in a preliminary stage. Malaysia signed separate joint-venture agreements to build two steel mills in Malaysia. In partnership with Tioxide Group PLC of the United Kingdom, Malaysia considered plans to build a $192 million titanium dioxide plant in Terengganu. A decision on construction will be made after the studies on technical, environmental, and financial aspects of the project are completed.

According to Malaysia's Ministry of Finance, Malaysia's real GDP, in 1978 constant dollars, was estimated at $23.5 billion, of which about $2.6 billion was contributed by the mining industry. Malaysia's economic growth rate, as measured by the change in real GDP, was estimated to be 7.5%, compared with 4.8% (revised) in 1987. The manufacturing sector, which contributed 24% to Malaysia's GDP in 1988, continued to be the major driving force of economic growth in Malaysia. The merchandise trade surplus was slightly lower than that of 1987 because of higher imports of capital goods for the expanding manufacturing industry. Merchandise exports were estimated to increase 18% to $20 billion wnile imports grew 30% to $15 billion. The inflation rate rose to 2.7% from 1.1% in 1987. Malaysia's labor force increased 3% to 6.6 million, while the

unemployment rate declined to 8.1% from 8.2% in 1987.

Production

The total output of the mining industry was estimated to have grown 8% from that of 1987 resulting from increased output of crude petroleum and natural gas. The output of crude petroleum rose to an average of 540,000 bbl/d, compared with 498,000 bbl/d in 1987. The output of natural gas reached a record 1.7 billion cubic feet per day in 1988. For the first time since 1960, Malaysia produced coal at an initial rate of 600,000 tons per year.

Despite improvement in the world's tin market, the tin industry could not hold the 1987 upward momentum in tin production because of high production cost and declining ore grade. As a result, Brazil passed Malaysia as the world's largest tin producer. Many small-scale tin mines, mainly gravel pumping operations, remained shut. Operators were cautious about reopening while the Government continued to enforce export controls that gave existing tin mines preference over the newly opened and reopened mines.

Production of bauxite and iron ore was lower than that of 1987 because of reduced exports. Production of copper concentrate also declined because a lower grade of ore was mined. Overall gold production remained unchanged. Production of ilmenite, monazite, and zircon concentrate, recovered from tailings of tin mining, continued to increase because of the growing demand in the Far East market. Production of kaolin and barite increased because of increased domestic and overseas demand.

Production of rare earths and yttrium oxide decreased because of strong environmental concerns by local residents about low-level radioactive waste. Production of sponge iron for exports on Labuan Island off Sahah remained at capacity while crude steel production at the Telok Kalong steel mill in Teregganu was lower than that of 1987 because of raw material shortage. Production of refined tin by two tin smelters was higher resulting from toll smelting of overseas tin concentrate. The two tin smelters had been toll smelting for Australia, Bolivia, and China in the past years. Production of LNG and nitrogen fertilizer in Bintulu, Sarawak, was at full capacity.

Trade

Malaysia's merchandise exports rose to an estimated $20.8 billion from $17.7 billion (revised) in 1987 while imports also rose to $15.4 billion from $11.8 billion (revised) in 1987. As a result, Malaysia's trade surplus was estimated to decline by 8.9% to $5.5 billion. The increase in export earnings was largely attributable to more exports of oil and gas as well as of manufactured products such as electronic components, telecommunication equipment, and textiles. Increased imports of capital goods for manufacturing facilities and production of primary commodities pushed up total imports.

In mineral trade, Malaysia exported more than 55% of its crude petroleum output, in decreasing order of value, to Singapore, Japan, the Republic of Korea, Thailand, and the Philippines. All exports of natural gas were to Japan. Exports of tin, in decreasing order of value, were to Japan, the Netherlands, the United States, and Singapore. Malaysia continued to ship all copper concentrate, and most bauxite, ilmenite, rare earths, and zircon concentrate to Japan.

In order of significance, Japan, the United States, and Singapore were the major trading partners of Malaysia. The United States became the second leading trade partner because of increased exports of manufactured goods to the United States in 1988. The United States accounted for 16.8% of Malaysia's exports and 17.4% of Malaysia's imports.

Commodity Review

***Metals.*—Aluminum and Bauxite.**—Production of bauxite from an open pit, operated by Promet Berhad Group, in the Pengerang (Telok Ramunia) area of Johore declined to an average rate of 34,400 tons per month from 40,200 tons per month in 1987. The lower production was caused by reduced exports to Japan. In 1988, Malaysia's Department of Mines reportedly was undertaking preliminary investigations of potential bauxite resources in central Peninsular Malaysia. Reconnaissance drilling by the Geological Survey of Malaysia in recent years delineated indicated reserves of 50 million tons of washed bauxite grading more than 48% Al_2O_3 in the Bukit Goh area of Pahang and 17 million tons of the same grade bauxite in the Jabor Valley area of Terengganu.

In November, the Government of Malaysia approved in principle the construction of a $400 million aluminum smelter in the Bintulu area of Sarawak. The project was initially proposed by the Japanese Government as part of a joint investment program with the Association of Southeast Asian Nations (ASEAN) countries. The production license for the 115,000-ton-per-year smelter was still awaiting an environmental impact assessment based on the Environmental Quality Act of 1987 and final approval of the Ministry of Science, Technology, and Environment. In the preliminary stage, an unnamed French company reportedly would hold a majority equity interest in the project, provide technology, and manage the smelter project. However, the supply sources of alumina and energy remained uncertain.[45]

Copper.—Production of copper concentrate from the Mamut Mine in Sabah dropped by 17% because of declining ore grade. For the first 6 months, the monthly output averaged 8,240 tons compared with 9,930 tons for the same period in 1987. The 1988 output was estimated at 100,000 tons of concentrate containing 24,000 tons of copper, 64,000 troy ounces of gold, and 369,733 troy ounces of silver. All copper concentrate was exported to Japan.

TABLE 12

MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Aluminum: Bauxite, gross weight	thousand tons	680	492	r566	482	361
Antimony, mine output, Sb content (Sarawak)		17	12	—	129	—
Columbium and tantalum concentrate, gross weight		45	80	215	228	—
Cb content of columbium[e]		7	12	32	34	—
Ta content of tantalum[e]		3	6	15	16	—
Copper, mine output, Cu content (Sabah)		28,852	30,507	28,301	29,861	22,014
Gold, mine output, Au content:						
Malaya	troy ounces	7,041	7,115	8,839	14,204	e20,400
Sabah	do.	82,012	78,818	71,396	87,333	e64,200
Sarawak	do.	474	4,371	6,791	10,136	e13,400
Total	**do.**	**89,527**	**90,304**	**87,026**	**111,673**	**e98,000**
Iron and steel:						
Iron ore and concentrate	thousand tons	194	182	208	161	272
Steel, crude	do.	350	550	750	750	e550
Rare-earth metals: Monazite, gross weight		r4,451	5,808	5,959	2,908	2,920
Silver, mine output, Ag content						
Sabah	thousand troy ounces	470	522	452	497	e325
Sarawak[3]	do.	—	—	—	10	e10
Tin:						
Mine output, Sn content		41,307	36,884	29,135	30,388	28,866
Metal, smelter		46,911	45,500	43,788	44,363	49,945
Titanium: Ilmenite concentrate, gross weight		r176,916	r315,736	414,941	509,202	486,305
Tungsten, mine output, W content		r371	r13	r4	—	e20
Zirconium: Zircon concentrate, gross weight		r6,732	11,652	12,633	17,828	25,671
INDUSTRIAL MINERALS						
Barite		23,421	23,394	r17,677	38,935	38,766
Cement, hydraulic	thousand tons	3,469	3,128	3,176	2,922	3,464
Clays: Kaolin		72,472	82,576	85,052	96,882	116,869
Nitrogen: N content of ammonia		38,900	53,400	r250,600	321,300	300,600
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural (Sarawak):						
Gross	million cubic feet	398,700	483,224	525,965	580,350	693,500
Petroleum:[4]						
Crude	thousand 42-gallon barrels	163,082	156,950	183,814	181,724	197,799
Refinery products:						
Gasoline	do.	8,288	8,745	8,808	9,130	9,804
Jet fuel	do.	2,642	e2,650	e2,700	e2,900	e3,000
Kerosene	do.	4,623	3,461	3,876	3,943	4,041
Distillate fuel oil	do.	14,351	11,719	10,293	10,183	10,753
Residual fuel oil	do.	11,585	7,543	8,298	8,350	9,107
Other[5]	do.	3,929	e11,492	e11,500	e12,000	e12,500
Total	**do.**	**45,418**	**e45,610**	**e45,475**	**re46,506**	**e49,205**

[e] Estimated. [p] Preliminary. [r] Revised.

[1] All production is from Peninsular Malaysia (Malaya) unless otherwise specified. Table includes data available through June 13, 1989.

[2] In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone), fertilizers, and salt are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[3] Byproduct from gold mines in Sarawak.

[4] Includes production from Malaya, Sabah, and Sarawak.

[5] Includes liquefied petroleum gas, naphthas, and lubricants.

TABLE 13

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	362,100	412,600	103,700	Japan 209,100; Ireland 50,500.
Metal including alloys:				
Scrap	7,115	8,993	—	Japan 8,010; Singapore 613.
Unwrought	62	237	—	Singapore 170; Hong Kong 40.
Semimanufactures	7,320	8,805	10	Singapore 4,445; Hong Kong 1,206; China 1,100.
Antimony: Ore and concentrate	20	NA		
Columbium and tantalum: Ore and concentrate	45	NA		
Copper:				
Ore and concentrate	125,767	118,758	—	All to Japan.
Matte and speiss including cement copper	95	18	—	All to Republic of Korea.
Metal including alloys:				
Scrap	12,354	14,637	123	India 4,325; Republic of Korea 4,057; Singapore 3,188.
Unwrought	134	—		
Semimanufactures	20,947	4,021	64	Singapore 3,200; Hong Kong 248.
Gold:				
Waste and sweepings kilograms	231	NA		
Metal including alloys, unwrought and partly wrought troy ounces	26,172	NA		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	13,134	34,856	—	China 25,800; Singapore 9,026.
Metal:				
Scrap	21,530	45,990	12	Singapore 37,983; Indonesia 6,970.
Pig iron, cast iron, related materials	286,396	354,884	—	India 222,004; Indonesia 66,071.
Ferroalloys, unspecified	35	44	—	All to Singapore.
Steel, primary forms	11	8,967	—	Singapore 5,933; Japan 3,000.
Semimanufactures:				
Bars, rods, angles, shapes, sections	39,801	146,960	31,491	Singapore 79,851; China 19,071; Japan 11,322.
Universals, plates, sheets	2,153	7,945	—	Singapore 7,248.
Hoop and strip	98	481	—	Singapore 454.
Rails and accessories	560	1,914	—	Singapore 1,913.
Wire	598	1,178	3	Singapore 728; Hong Kong 389.
Tubes, pipes, fittings	30,142	53,861	5,528	Singapore 22,934; Netherlands 13,540.
Castings and forgings, rough	1,177	550	4	Singapore 518.
Unspecified	33	—		
Lead: Metal including alloys:				
Scrap	NA	90	—	All to Singapore.

See footnotes at end of table.

TABLE 13—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
METALS—Continued					
Lead: Metal including alloys—Continued					
Unwrought		624	1,101	—	Indonesia 768; Singapore 162.
Semimanufactures		70	24	8	Singapore 9; Republic of Korea 3.
Magnesium: Metal including alloys, all forms		—	34	—	Japan 21; West Germany 7.
Mercury	76-pound flasks	406	NA		
Nickel:					
Metal including alloys:					
Scrap		107	69	14	Japan 17; India 8.
Unwrought		106	10	—	Philippines 6; Japan 2.
Semimanufactures		40	146	1	Japan 120.
Platinum-group metals: Metals including alloys, unwrought and partly wrought[2]	value thousands	$52	$125	$13	Papua New Guinea $57; Bahrain $38.
Silver:					
Waste and sweepings[2]	do.	$2,899	$3,175	$2,901	Singapore $177.
Metal including alloys, unwrought and partly wrought	do.	$69	$86	$3	Japan $60; Singapore $20.
Tin: Metal including alloys:					
Scrap		495	204	—	Singapore 129; Hong Kong 57.
Unwrought		57,481	40,658	2,991	Japan 12,955; Singapore 4,485; Netherlands 3,336.
Semimanufactures		892	584	—	United Kingdom 339; Hong Kong 65; Republic of Korea 44.
Titanium:					
Ore and concentrate		249,625	NA		
Oxides		32	NA		
Metal including alloys, all forms		30	—		
Tungsten:					
Ore and concentrate		30	10	—	All to West Germany.
Metal including alloys, all forms		4	3	—	Japan 2.
Uranium and/or thorium: Ore and concentrate	value, thousands	$1,048	$355	$46	France $298.
Zinc:					
Oxides		64	57	—	India 32; Singapore 25.
Metal including alloys:					
Scrap		690	1,076	—	India 430; Singapore 253.
Unwrought		20	1	—	All to Singapore.
Semimanufactures		248	277	—	Singapore 225; Indonesia 31.
Zirconium:					
Ore and concentrate		2,499	NA		

See footnotes at end of table.

TABLE 13—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
METALS—Continued					
Other:					
Ores and concentrates		—	401,758	—	Japan 249,790; Republic of Korea 43,523.
Ashes and residues		11,484	9,743	—	Singapore 8,856.
INDUSTRIAL MINERALS					
Asbestos, crude		49	—		
Barite and witherite		8,155	9,664	—	All to Singapore.
Cement		298,781	551,089	—	Singapore 455,181; Bangladesh 94,566.
Chalk		—	415	—	All to Singapore.
Clays, crude		37,494	54,371	—	Japan 23,135; Singapore 13,844.
Diamond:					
Gem, not set or strung	value, thousands	$9,606	$12,006	$740	Belgium-Luxembourg $10,672.
Industrial stones	do.	$30	$191	—	Belgium-Luxembourg $135; United Arab Emirates $56.
Diatomite and other infusorial earth		29	16	—	Singapore 12.
Fertilizer materials: Manufactured:					
Ammonia	value, thousands	$1,126	$3,953	—	Philippines $2,408; Thailand $454.
Nitrogenous		16,330	264,655	20,473	Thailand 75,489; Australia 58,739.
Phosphatic		30	76	—	All to Singapore.
Potassic		95	860	—	Thailand 401; Singapore 199.
Unspecified and mixed		3,272	3,430	—	Singapore 3,420.
Graphite, natural		—	216	—	Japan 215.
Gypsum and plaster		21	61	—	Singapore 46; Brunei 15.
Lime		9,070	10,754	—	All to Singapore.
Mica:					
Crude including splittings and waste		862	1,765	—	Japan 913; Republic of Korea 540.
Worked including agglomerated splittings		95	—		
Phosphates, crude		1,978	2,104	—	Singapore 1,177; Hong Kong 900.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$754	$394	—	United Arab Emirates $161; Saudi Arabia $119.
Synthetic	do.	$609	$1,397	$2	Japan $1,394.
Pyrite, unroasted		—	16	—	Singapore 14.
Salt and brine		604	6,482	—	Singapore 5,780; Indonesia 374.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		32	29	—	Papua New Guinea 18; Singapore 8.
Sulfate, manufactured		52	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		417,352	[3]4,167	—	Mainly to Singapore.

See footnotes at end of table.

TABLE 13—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Dimension stone—Continued					
Worked		209	751	—	Singapore 443; Hong Kong 237.
Dolomite, chiefly refractory-grade		272	281	—	Singapore 245.
Gravel and crushed rock		99,847	109,487	—	Brunei 93,976; Singapore 15,510.
Limestone other than dimension		31,718	33,175	—	Singapore 32,709.
Quartz and quartzite		1,844	6,358	—	Brunei 5,750; Singapore 608.
Sand other than metal-bearing		1,276,611	2,644,451	—	Singapore 2,495,579; Japan 105,388.
Sulfur:					
Elemental:					
Crude including native and byproduct		4	17	—	Singapore 15.
Colloidal, precipitated, sublimed		3	19	—	Thailand 12.
Dioxide		16	NA		
Sulfuric acid		175	134	—	All to Singapore.
Talc, steatite, soapstone, pyrophyllite		20	142	—	Japan 126.
Other:					
Crude		256	337	10	Japan 179; Thailand 71.
Slag and dross, not metal-bearing		4,519	6,311	—	Japan 6,048.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		14,231	4,445	—	Indonesia 3,033; India 486.
Coal, all grades including briquets		NA	70,367	651	Panama 16,471; Liberia 10,880; Japan 6,617.
Gas, natural: Liquefied	value, thousands	$926,167	$749,020	—	Japan $746,340.
Petroleum:					
Crude	thousand 42-gallon barrels	120,917	145,836	4,043	Japan 51,668; Singapore 32,598; Republic of Korea 23,171.
Refinery products:					
Liquefied petroleum gas	value, thousands	$22,837	NA		
Gasoline	thousand 42-gallon barrels	3,061	3,303	—	Japan 2,005; Singapore 1,107.
Kerosene and jet fuel	do.	3,498	3,958	—	Singapore 1,912; Japan 909; India 776.
Distillate fuel oil	do.	2,085	1,979	—	Thailand 1,454; Singapore 523.
Lubricants	do.	9	3	(4)	Singapore 1.
Residual fuel oil	do.	4,910	6,615	282	Singapore 3,868; Japan 1,875.

NA Not available.

[1] Table prepared by Audrey D. Wilkes.

[2] May include other precious metals.

[3] Excludes unreported quantity valued at $2,730,000.

[4] Less than 1/2 unit.

TABLE 14

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	4	19	(2)	Australia 7; United Kingdom 3.
Aluminum:				
Ore and concentrate	1,001	1,319	—	Mainly from China.
Oxides and hydroxides	5,438	12,300	73	Japan 5,964; Australia 5,813.
Metal including alloys:				
Scrap	1,272	1,339	—	Thailand 616; Japan 418; Singapore 305.
Unwrought	21,753	26,449	101	Australia 10,663; Canada 8,303.
Semimanufactures	13,559	9,282	391	Japan 3,681; Singapore 1,762.
Chromium:				
Ore and concentrate	23	8	—	All from Japan.
Oxides and hydroxides	109	161	17	Netherlands 51; Singapore 41.
Cobalt:				
Oxides and hydroxides	22	12	(2)	Singapore 6; Belgium-Luxembourg 3.
Copper:				
Ore and concentrate	31	3	—	Singapore 2.
Matte and speiss including cement copper	2	81	1	Japan 68; Singapore 12.
Metal including alloys:				
Scrap	906	987	—	Thailand 634; Singapore 290.
Unwrought	20,745	8,827	1	Zambia 5,941; Chile 2,560.
Semimanufactures	16,126	17,428	—	Japan 7,236; Singapore 2,224; Chile 2,198.
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite	830,524	1,026,495	—	Brazil 586,398; Sweden 265,319; Australia 119,280.
Metal:				
Scrap	33,508	4,219	165	Singapore 3,311; Japan 564.
Pig iron, cast iron, related materials	3,563	1,657	7	Japan 1,008; Brazil 424.
Ferroalloys:				
Ferromanganese	6,578	5,927	3	Australia 2,443; France 1,650; Japan 1,496.
Unspecified	3,720	8,370	320	Norway 2,783; Australia 1,593.
Steel, primary forms	351,167	46,929	41	Netherlands 27,158; Brazil 18,741.
Semimanufactures:				
Bars, rods, angles, shapes, sections	260,261	169,450	223	Japan 70,939; United Kingdom 27,681; Republic of Korea 9,834.
Universals, plates, sheets	693,569	708,825	4,250	Japan 425,991; Republic of Korea 94,755; West Germany 38,259.
Hoop and strip	15,399	12,593	53	Japan 7,121; United Kingdom 1,945; Republic of Korea 1,552.
Rails and accessories	12,126	19,409	10	Poland 18,403.
Wire	13,660	20,316	42	United Kingdom 6,055; China 5,903; Japan 2,729.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Tubes, pipes, fittings	153,805	110,772	8,018	Japan 89,337.
Castings and forgings, rough	1,514	1,557	9	China 455; Singapore 267; Japan 200.
Lead:				
Ore and concentrate	17	28	—	Thailand 26.
Oxides	820	304	2	Singapore 135; Australia 119.
Metal including alloys:				
Scrap	4,666	1,053	—	Japan 775; Singapore 265.
Unwrought	12,291	11,658	197	Australia 5,443; Burma 1,820.
Semimanufactures	5,916	1,717	7	Singapore 642; Australia 395; Japan 312.
Magnesium: Metal including alloys, all forms	28	41	3	Japan 15; Norway 9; West Germany 8.
Manganese:				
Ore and concentrate	1,128	985	—	Singapore 554; Brazil 296; Mexico 90.
Oxides	1,607	1,106	—	Japan 563; Singapore 365; China 102.
Mercury 76-pound flasks	232	174	—	Algeria 58; China 58.
Molybdenum: Metal including alloys, all forms	12	12	2	Belgium-Luxembourg 5.
Nickel:				
Ore and concentrate	2	15	(2)	Finland 7; United Kingdom 5.
Matte and speiss	81	41	—	Japan 22; Norway 17.
Metal including alloys:				
Scrap	3	22	—	Singapore 16.
Unwrought	104	133	21	Japan 35; Canada 28.
Semimanufactures	444	819	3	Singapore 606; Italy 88.
Platinum-group metals: Metal including alloys, unwrought and partly wrought value, thousands	$370	$329	$4	Singapore $307.
Silver:				
Ore and concentrate do.	$11	$41	$2	United Kingdom $27; Japan $8.
Waste and sweepings do.	—	$139	$90	Singapore $25; Hong Kong $18.
Metal including alloys, unwrought and partly wrought do.	$1,264	$752	$90	Japan $271; Hong Kong $131; West Germany $128.
Tin:				
Ore and concentrate	13,634	23,806	—	Australia 14,929; China 4,100; Indonesia 1,499.
Metal including alloys:				
Scrap	3	—		
Unwrought	795	600	263	Singapore 218.
Semimanufactures	305	161	50	Singapore 65; Hong Kong 13.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Titanium: Oxides	7,623	7,616	1,246	Japan 1,686; United Kingdom 1,675; Australia 1,449.
Tungsten:				
Ore and concentrate	22	56	1	India 54.
Metal including alloys, all forms	41	146	4	Japan 86; Sweden 25.
Uranium and/or thorium: Ore and concentrate value, thousands	$857	$157	—	Australia $132; Thailand $25.
Zinc:				
Ore and concentrate	23	30	—	Mainly from Australia.
Oxides	251	205	10	West Germany 66; United Kingdom 52; China 27.
Metal including alloys:				
Scrap	64	138	—	Singapore 103.
Unwrought	18,230	14,894	7	Australia 9,677; Thailand 2,402.
Semimanufactures	976	1,152	23	Australia 586; Singapore 150; Japan 137.
Other:				
Ores and concentrates	(3)	2,597	—	Thailand 1,508; Australia 588; Japan 373.
Ashes and residues value, thousands	$265	$963	$1	Japan $698; Brazil $162.
Base metals including alloys, all forms do.	$868	$844	$61	Canada $417; Thailand $131.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	149	228	29	Japan 74; Indonesia 31.
Artificial: Corundum	3	28	—	Australia 23.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$45	$41	—	All from Japan.
Grinding and polishing wheels and stones do.	$3,191	$2,849	$180	Japan $1,230; China $298.
Asbestos, crude	19,064	16,947	2,187	Canada 5,499; Singapore 3,905; Zimbabwe 3,780.
Barite and witherite	12,725	10,437	1	NA.
Boron materials:				
Crude natural borates	51	73	41	China 25.
Oxides and acids	203	402	180	China 150.
Cement	770,673	64,545	108	Singapore 34,731; Japan 16,551.
Chalk	806	869	—	United Kingdom 551; Australia 223.
Clays, crude	59,358	90,916	82,770	United Kingdom 2,618; China 1,034.
Cryolite and chiolite	10	—		
Diamond:				
Gem, not set or strung value, thousands	$25,309	$24,042	$236	Belgium-Luxembourg $12,390; United Kingdom $5,600.
Industrial stones do.	$48	$24	$18	Singapore $6.
Diatomite and other infusorial earth	489	788	584	Philippines 164.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Feldspar, fluorspar, related materials	24,246	20,866	508	India 11,884; Thailand 5,557; China 1,552.
Fertilizer materials:				
Crude, n.e.s.	39,339	40,109	—	Singapore 39,886.
Manufactured:				
Ammonia	4,797	339	9	West Germany 107; Indonesia 76; Japan 73.
Nitrogenous	513,232	388,272	157	Indonesia 182,604; Japan 109,435.
Phosphatic	11,755	15,216	3,708	China 7,091; Republic of Korea 2,087.
Potassic	510,310	466,456	10,988	Canada 199,987; U.S.S.R. 111,208; West Germany 77,491.
Unspecified and mixed	188,721	136,509	3,528	West Germany 50,147; Belgium-Luxembourg 40,958.
Graphite, natural	903	510	4	West Germany 242; Japan 114.
Gypsum and plaster	185,991	152,528	89	Thailand 146,436.
Lime	7,211	5,942	—	Thailand 5,684.
Magnesium compounds: Magnesite, crude including calcined	9,645	5,595	5	China 3,231; Japan 1,374.
Mica:				
Crude including splittings and waste	118	87	4	India 31; United Kingdom 22; Singapore 12.
Worked including agglomerated splittings	15	13	—	France 12.
Nitrates, crude	64	27	5	China 20.
Phosphates, crude	374,645	283,857	440	Christmas Island 172,384; Jordan 80,677.
Pigments, mineral: Iron oxides and hydroxides, processed	1,969	1,361	65	West Germany 493; United Kingdom 206; Japan 151.
Potassium salts, crude	287	10	—	All from West Germany.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$1,646	$2,436	$2	Switzerland $892; Singapore $493; West Germany $356.
Synthetic do.	$421	$410	—	Japan $314; Thailand $91.
Pyrite, unroasted	4	—		
Salt and brine	146,470	152,962	78	Australia 67,471; Thailand 44,411.
Sodium compounds, n.e.s.: Carbonate, manufactured	32,172	50,680	22,102	Kenya 22,639; West Germany 3,145.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	11,937	1,572	16	Italy 811; India 133.
Worked	11,986	8,383	5	Italy 6,189; China 561.
Dolomite, chiefly refractory-grade	5,211	2,605	—	Japan 60; unspecified 2,500.
Gravel and crushed rock	2,467	1,607	37	Japan 316; New Zealand 198; France 195.
Limestone other than dimension	5,655	7,443	—	Philippines 4,450.
Quartz and quartzite	191	51	—	West Germany 24; Japan 23.
Sand other than metal-bearing	3,046	1,480	128	Japan 675; New Zealand 282.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		12,290	886	39	West Germany 238; Australia 140; Republic of Korea 128.
Colloidal, precipitated, sublimed		10,798	22,796	17	Singapore 19,012; China 3,040.
Sulfuric acid		2,119	1,591	47	Singapore 1,179; West Germany 341.
Talc, steatite, soapstone, pyrophyllite		5,473	7,010	43	China 4,577; Republic of Korea 1,550.
Other:					
Crude	value, thousands	$542	$337	$10	Japan $179; Thailand $71.
Slag and dross, not metal-bearing		9,346	10,233	2	Japan 8,187; Singapore 2,022.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		60,125	36,887	20	Singapore 33,672; China 500.
Carbon black		1,116	1,423	265	Singapore 233; Japan 112; West Germany 90.
Coal:					
Anthracite and bituminous including briquets		491,831	380,417	(2)	Indonesia 257,783; Australia 104,344.
Lignite including briquets		57	16	—	All from Australia.
Coke and semicoke		16,116	20,883	—	Japan 15,053; Australia 4,540.
Peat including briquets and litter		93	4	4	
Petroleum:					
Crude	thousand 42-gallon barrels	16,452	14,131	—	Kuwait 7,458; Oman 2,535; Saudi Arabia 2,508.
Refinery products:					
Liquefied petroleum gas	value, thousands	$21,504	$19,017	$27	Singapore $16,846.
Gasoline	thousand 42-gallon barrels	4,604	7,496	4	Singapore 7,363.
Mineral jelly and wax	do.	61	53	8	China 12; Indonesia 9.
Kerosene and jet fuel	do.	1,723	1,759	(2)	Singapore 1,745.
Distillate fuel oil	do.	8,284	7,176	—	Singapore 6,906.
Lubricants	do.	601	644	13	Singapore 476; Australia 44.
Residual fuel oil	do.	10,485	(4)	—	Mainly from Singapore.
Bitumen and other residues	do.	310	533	(2)	Singapore 525.
Bituminous mixtures	do.	16	20	(2)	Singapore 13; Australia 5.
Petroleum coke	do.	39	45	17	Indonesia 28.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $455,000.
[4] Unreported quantity valued at $162,000.

Japanese trade statistics, show that imports of copper concentrate from Malaysia dropped to 104,040 tons from 134,653 tons in 1987.

After reorganization in 1987, the Mamut Mine reportedly was owned by Mamut Copper Mining Sdn. Bhd. of Malaysia, a majority equity holder; Bonanza Mining Co. Ltd. of Malaysia, and Sabah Mining Development Co. Ltd. (SMD) of Japan. SMD is a consortium of the seven major Japanese copper smelters, led by Mitsubishi Metal Corp.

Gold.—Overall production of gold remained at 1987 levels. Production from placer deposits in the Raub area of Pahang and the Bau area of Sarawak increased considerably, but gold produced as a byproduct of copper mining in Sabah declined because of the lower output of copper concentrate.

In January, the Government of Malaysia announced that it would promote joint-venture exploration and development of gold and other minerals with foreign companies. According to the Kelantan State Government, a 173-hectare area around Pulai and Gua Musang had been identified for gold mining. Dome Resources N.L. of Australia, which signed a joint-venture agreement with the State of Kelantan in 1987, announced in September that it had identified 31 potential hard-rock gold deposits in its leasing area in Kelantan.

According to a local press report, gold deposits have been discovered at Bukit Lubok Mandi, near Kuala Terengganu. Hundreds of prospectors reportedly obtained permits from the local district council to recover gold, mainly by panning, in the area.

In September, a small-scale gold open pit near Pulai in the southern Kelantan began operation. This gold project was a joint venture of Malaysia Mining Corp. (MMC) and a local company called Permodalan Kelantan Bhd. The mine was expected to produce 9,645 troy ounces of gold per year with 200 workers.[46]

Steel.—In an effort to reduce Malaysia's import reliance on flat steel and stainless steel wire products, separate joint-venture agreements were signed in 1988 to build two steel production facilities in Malaysia. Maruichi Malaysia Steel Tube Bhd., a subsidiary of Maruichi Steel Tube of Japan, announced that under a joint-venture agreement signed in July, Malaysia and Japan would build a $38 million cold-rolled strip mill at Kelang near Kuala Lumpur. Preparation of the site began in October, and construction of the cold reversing mill was expected to start in early 1989. The mill, scheduled for completion in the spring of 1990, would have an initial capacity of 70,000 tons per year or 23% of Malaysia's cold-rolled steel demand. Because Malaysia lacks hot coil production facilities, the input for the cold rolling mill would have to be imported.[47]

In November, a joint-venture agreement was signed between Perdama Corp. of Malaysia and the Chinese Metallurgical Construction Corp. (CMCC) to construct a $12 million plant for production of stainless steel wire and other alloyed steel products. The plant would have an initial capacity of 3,500 tons per year. Perdama was to invest about $8.5 million in the project.

Tin.—Despite further improvement in the price of tin on the Kuala Lumpur Tin Market (KLTM), Malaysia lost its position as the world's largest tin producer to Brazil in 1988. The high production cost and declining ore grade made it difficult for Malaysia to compete with lower cost tin producers such as Brazil and Indonesia.

Following implementation of the so-called Supply Rationalization Scheme (SRS) (export controls) by ATPC in March 1987, the prices of tin on the KLTM had moved up to $6.92 per kilogram from $6.67 in 1987 and $5.97 in 1986. According to a Malaysian industry source, the average production cost for the majority of tin mines in Malaysia remained between $6.00 and $7.00 per kilogram. The dredging sector, however, had reduced its production cost to about $5.56 per kilogram, almost equal to cost in Indonesia. Many previously closed tin mines reportedly would not resume operations unless the price of tin stabilized at about $9.00 per kilogram and unless lower cost producers did not raise their output.

For the first 11 months, tin production dropped 5.5% to 26,370 tons, from 27,914 tons in the same period of 1987. Fewer mines were operating; according to Malaysia's Department of Mines, the average number of operating mines dropped to 220 from 230 in 1987. Of the tin produced in the first 11 months, 46% was by dredging, 35% by gravel pumping, 8% by open pits, and 11% by other methods. Employment in the tin industry remained at 11,000 in 1987–88. Export earnings from tin reportedly rose to $361 million from $333 million in 1987 owing to higher prices of tin in 1988.

Following a 4-day meeting in Kuala Lumpur in January, ATPC revised export quotas for the second year's SRS from 96,027 tons to 101,900 tons effective from March 1, 1988, to February 28, 1989. Malaysia's export limit was raised to 31,650 tons from 28,526 tons. Brazil and China reportedly agreed to cooperate with ATPC by limiting their tin exports to 26,500 tons and 10,000 tons, respectively. The world tin surplus was around 47,700 tons in early 1988 and was reduced to 34,000 tons by yearend. According to some industry analysts, the price of tin could be stabilized between $8.50 and $9.20 per kilogram when the tin surplus is reduced to 20,000 tons and supply and demand are in balance.

Tin control regulations in Malaysia were enforced by the Tin Control Committee (TCC). The committee was chaired by the Director-General of the Department of Mines. Its members included officials from the Ministry of Primary Industry and various tin mining associations, tin smelters, and tin

byproducts producers. The committee administered applications for new and reopened mines and monitored closely the tin output of each mine against their quotas. Under the second year's SRS, the TCC gave priority in allocating the output quota to existing mines (active on or before March 1, 1988) over new mines. The proportion of production cutback for new mines was twice that for existing mines. In the second year's SRS, the TCC tightened production controls by making quarterly comparisons of the output of each tin mine with their quotas.[48]

In August, the State government of Perak proposed to resume collection of royalties at the rate of 1% on tin sales when the price on the KLTM was less than $6.90 per kilogram; 1.5% when the price was between $6.90 and $8.05, and at 2% when the price was over $8.05 per kilogram. Four national and State mining associations opposed the proposal and asked the Federal Government to intervene. In response, the Federal Government reportedly expressed a willingness to discuss with the Perak State government the postponement of levying royalties until the world tin surplus is reduced to 22,000 tons. In the meantime, the Federal Government will provide some form of compensation to the State of Perak. The issue remained unresolved by yearend.

In March, the Sungei Lembing Mine, the country's largest and deepest underground tin mine near Kuantan in the State of Pahang, was closed permanently by the State government. Pahang Investments Public Ltd. Co. stopped tin production in 1986. Following the failure of a takeover attempt by MMC in 1987, a proposal to revive mining operations of the Sungei Lembing Mine by an unnamed British mining company did not materialize. According to a State official, more than $1.2 million had been spent to keep the tunnels from flooding. The Pahang government would not continue to spend money to keep the mine open in the absence of any commitment from the mining company to take over the mine.

About 93% of Malaysia's tin production was exported to Japan, the Netherlands, the United States, and Singapore. Domestic tin consumption was estimated at 2,000 tons, of which 58% was consumed by manufacturers of solder, 27% by manufacturers of tinplate, and 15% by the pewter industry.

Because of growing domestic demand for tinplate, Perstima, Malaysia's sole producer of tinplate, announced in early 1988 that it planned to invest $40 million to double its capacity to 180,000 tons per year by building a second electrolytic tinning line. Perstima's plant, in Pasir Gudang, Johore, increased its tinplate production to 95,400 tons from 85,500 tons in 1987. Malaysia's domestic demand for tinplate in 1988 was estimated at 120,000 tons. According to Perstima, its 1988 ex-warehouse price of tinplate was about 2% lower than imports from Japan.[49]

Titanium.—Tioxide Group PLC of the United Kingdom planned to invest $192 million in Malaysia for a titanium dioxide pigment plant in the State of Terengganu. Construction of the plant reportedly has been approved by the Malaysia Industrial Development Authority (MIDA). However, a final decision has not been made pending completion of feasibility studies on technical, environmental, and financial aspects of the project. According to an official of MIDA, if the plant is technically feasible, environmentally acceptable, and financially viable, construction would be started in July 1989 in Teluk Kalong.[50]

Other Metals.—Malaysia produced a variety of heavy metals and rare-earth concentrates as byproducts from tailings of alluvial tin mining operations, mainly in the States of Perak and Selangor. Since 1984, production of tin byproducts, especially ilmenite and zircon, had grown considerably because of increased demand from Japan, the Republic of Korea, and Taiwan.

In mid-1988, 68 tin tailings treatment plants were operating in Malaysia. The tailings from alluvial tin mines in the States of Perak and Selangor in general included small amounts of cassiterite and ilmenite and still smaller percentages of columbite, monazite, rutile, struverite, xenotime, and zircon. Content of these minerals varied by location. In 1988, Malaysia's two largest processors of tin tailings in Malaysia were Syarikat Pendorong Sdn. Bhd. and Beh Minerals Sdn. Bhd.[51]

Syarikat Pendorong, established in 1977, was the largest processor of ilmenite in Malaysia. It operated a plant near the city of Kampar, about 32 kilometers south of Ipoh in Perak. Syarikat Pendorong obtained its raw materials—tin tailings generated by MMC's dredges—under a special arrangement with Pernas Charter Management, a wholly owned mine management subsidiary of MMC. The tailings were trucked to a 10-acre yard and stockpiled by source. Each pile was analyzed for its chemical composition before processing.

The average throughput of Syarikat Pendorong's plant was 15,000 tons per month, working two shifts per day and 6 days per week. The daily production capacity of ilmenite and zircon was 300 tons and 13 tons, respectively, in 1988. The plant was also capable of producing 9 to 10 tons per day of monazite, xenotime, and struverite combined when the accumulated volume of tailings was adequate to justify running a batch operation.

Syarikat Pendorong produced two grades of ilmenite concentrate (FeO-grade containing 50% to 56% TiO_2 and 26% to 30% FeO, and TiO_2-grade containing 59% to 60% TiO_2 and 7% to 12% FeO); zircon concentrate containing 63% to 64% ZrO_2; and monazite containing 55% to 60% rare-earth oxides (REO). These products were shipped to MMC Marketing Bhd., another wholly owned subsidiary of MMC, for distribution to the world market.

Beh Minerals, established in 1969, was the largest processor of rare earths in Malaysia. Its processing plant, at Lahat, is about 6 kilometers west of Ipoh, Perak. Beh Minerals obtained its raw materials through open tenders from tin tailings treatment plants in Australia and Thailand as well as from Malaysia.

Beh Minerals said its processing capacity was flexible and that its output of rare earths and heavy metals depended upon the volume and chemical composition of the raw materials it stockpiled. Certain types of rare earths or heavy metals were produced only when there was a market for them. However, the plant's normal throughput was 1,000 tons per month. It was operating 10 hours per day in mid-1988, but operations could be expanded to 16 hours per day. The main products by Beh Minerals were monazite, xenotime, ilmenite, struverite, and zircon. Monazite concentrate was shipped to affiliated companies for further processing.

Asian Rare Earth Ltd. (ARE), a joint venture of Beh Minerals and Mitsubishi Chemical Industries Ltd. of Japan, processed monazite concentrate into rare-earth chlorides (46% REO). ARE's monazite cracking plant in Ipoh, with an annual capacity of 3,000 tons, reportedly produced about 2,000 tons of rare-earth chlorides in 1988. A civil suit by local residents for improper safety measures for storing low-level radioactive waste was still unresolved.

Malaysian Rare Earth Corp. Sdn. Bhd. (MREC), joint venture of Beh Minerals (35%), Mitsubishi Chemical (35%), and local investors (30%), processed xenotime into yttrium oxide concentrate (60% Y_2O_3). Its xenotime cracking plant, also in Ipoh and with a rated capacity of 80 tons per year, reportedly was shut down in 1988 for environmental considerations.

Heavy metals produced by Beh Minerals included ilmenite containing 57% to 60% TiO_2; refractory-grade zircon containing 60% to 65% ZrO_2 plus some hafnium and rutile; and struverite containing 9% to 16% Ta_2O_5 and 9% to 16% Cb_2O_5 plus 4% to 5% ilmenite and 3% to 4% tin. Beh Minerals distributed its products through traders on the spot market. It also marketed its products directly to end users.

Malaysia exported ilmenite mainly to Japan, the Republic of Korea, and Taiwan; rare-earth minerals and concentrate to France, Japan, and the Netherlands; and zircon to Japan, the Republic of Korea, and Taiwan. The total export earnings from these heavy metals and rare-earth minerals were estimated at $18 million in 1987.

Industrial Minerals.—Production of kaolin has been increasing over the past decade because of growing domestic requirements and increased exports to the Far East market. Kaolin was mined mainly in the States of Perak, Johore, and Selangor by open pit methods. According to the Department of Mines, 18 mines were operating in 1988, mostly small-scale operations. About 60% of the kaolin was produced by two major mines operated in the Bidor area of Perak and in the Jemaluang area of Johore.

Domestic consumption of kaolin was estimated at 51,000 tons. Kaolin in Malaysia was used for filler in manufacturing rubber, paint, adhesives, and plastics. Kaolin was also used as raw material for production of floor and wall tiles, sanitary ware, and white cement. Malaysia exported about 46,000 tons of kaolin, valued at $4 million, principally to Japan, Singapore, and Taiwan.

The Government estimated kaolin ore reserves in Peninsular Malaysia, mainly in the States of Perak, Johore, and Selangor, at 190 million tons.[52]

Mineral Fuels.—**Coal.**—Coal had not been produced in Malaysia since the last coal mine was shut down in 1960. In 1988, a new open pit coal mine was started by Global Minerals Sarawak Sdn. Bhd. (GMS) in the Merit-Pila deposits in the Belawei-Mujan area north of Kapit in Central Sarawak. GMS is a joint venture of Global Minerals Corp. (GMC) of the United States and a South Korean-Malaysian consortium called Lucky Hill Sdn. Bhd. According to GMS, the initial output from the two deposits was expected to be 600,000 tons and to be increased to 2 million to 3 million tons by 1992. The company was also constructing a coal crusher at the port about 50 kilometers away from the mine.

According to the Geological Survey of Malaysia, during 1974–78, GMC prospected for coal with intensive pattern drilling at the Merit and Pila deposits in the Belawei-Mujan area. The Government granted GMC a mining certificate in 1982 and a mining lease on 2,485 hectares in the Belawei-Mujan and the Long Hill areas in 1985. The ore reserves recoverable by surface mining at that time were estimated at between 4.4 million and 5.2 million tons. However, according to the Ministry of Primary Industry, the coal reserves at the Merit-Pila deposits covering 1 hectare were estimated at 63 million tons of subbituminous coal with a low ash and sulfur content and a heating value of 6,200 kilocalories per kilogram.[53]

Malaysia imported annually about 400,000 tons of coal to meet its domestic demand. Malaysia's coal requirements were expected to jump to 2 million tons per year when Malaysia's first 300-megawatt coal-fired powerplant comes on-stream in 1989 at Port Klang along the west coast of Peninsular Malaysia.

Natural Gas.—Natural gas production from offshore Sabah, Sarawak, and Terengganu increased to a record 1.7 billion cubic feet per day. About 80% of natural gas production was by Sarawak Shell Bhd. (SSB) from the Central Luconia Gasfield off Sarawak and was turned into LNG and nitrogen fertilizer in Bintulu, Sarawak. The remaining 20% was produced by EPMI

and Sabah Shell Petroleum Co. (SSP). EPMI's output from the Duyong Gasfield and the Bekok Oilfield off Terengganu, went mostly into electrical power generation and production of LPG and sponge iron. SSP's production from the Samarang and Erb West Oilfields off Sabah was used mostly for electrical power generation and the production of methanol and sponge iron on Labuan Island off Sabah.

In 1988, two important agreements were reached in connection with the project to deliver offshore natural gas to Singapore and Peninsular Malaysia. The Government also awarded the pipeline construction contract to MMC Gas, a 55%-owned subsidiary of MMC.

A memorandum of understanding was signed in June between Malaysia and Singapore for the supply of natural gas and water to Singapore. Under the agreement, Singapore would purchase at least 150 million cubic feet per day of natural gas and a minimum of 250 million gallons per day of fresh water from Malaysia. The gas purchases would run for 15 years and Singapore would pay a minimum of $9.75 million for the first year. The agreed price reportedly was comparable to the price that Malaysia charged to its own Sultan Ismail power station in Paka, Terengganu.[54]

An agreement was signed in June between Malaysia and Japan for the Japanese Government to extend a $330 million (42 billion yen) soft loan to the Malaysian Government to finance the construction of the second phase natural gas project on Peninsular Malaysia. The loan was channeled through the Japanese Official Development Aid program to Malaysia and was provided from the Japanese Overseas Economic Cooperation Fund. The loan offered to Malaysia reportedly carried an annual interest rate of 4% for 25 years and had a 7-year grace period.[55]

In October, the Government awarded a contract through Petronas to MMC Gas for engineering, procuring, and constructing a $489 million three-segment gas pipeline system. It would link Chukai on the northeast coast of Terengganu and Segamat in Johore. At Segamat, one line would go south to Pasir Gudang near Johore Bahru and another west to Port Klang in Selangor. The second phase project was expected to be completed in 1992.

Petroleum.—To increase Government revenues and export earnings, Malaysia increased its crude petroleum output to an average of 540,000 bbl/d from 498,000 bbl/d in 1987. Much of the increase reportedly was attributable to the increased output by SSB from offshore oilfields. Of the total output, about 57% was produced by EPMI from oilfields off Terengganu in the South China Sea and the remainder from oilfields off Sabah and Sarawak, operated by SSB and SSP.

The producing oilfields operated by EPMI included Bekok, Guntong, Iron Barat, Kepong, Pulai, Tapis, Tinggi, Tiong, Seligi, and Semangkok. The oilfields operated by SSB included Barton, Erw West, Ketam, South Furious, St. Joseph, Semarang, and Tembungo. The oilfields operated by SSP included Bakau, Baram, Baronia, Bayan, Betty, Bokor, Fairley Baram, Siwa, Temana, Tukau, and West Lutong.

EPMI began production from its newly developed offshore platform in the Seligi Oilfield in the South China Sea at an initial rate of 20,000 bbl/d. According to a Malaysian oil industry source, six additional production platforms with a combined peak capacity of more than 100,000 bbl/d would be installed by 1994 at a total cost of $766 million. A total of 177 oil wells and 20 gas injection wells would be drilled from the seven platforms. The Seligi Oilfield, 275 kilometers off Terengganu and having oil reserves of 1.2 billion barrels, is the largest known oilfield in Malaysia.[56] As a result of increased output capacity from the Seligi Oilfield, the Government planned to raise Malaysia's crude petroleum output to 562,000 bbl/d in 1989.

In February, EPMI signed an agreement to jointly develop with Petronas Carigali Pty. Ltd., a subsidiary of Petronas, the Dulang Oilfield 126 kilometers off Terengganu at a cost of $389 million. The development project is scheduled for completion in late 1990 with a peak capacity of 67,000 bbl/d.

Following the signing of five production-sharing contracts by July 1987 for oil and gas exploration and development in Malaysia, 12 more contracts had been signed between August 1987 and December 1988. According to industry sources, the increased foreign interest in signing the contracts with the Malaysian Government was caused not only by the attractive conditions for exploration but also by the desire of foreign oil companies to add reserves to their portfolios in anticipation of a tighter oil market in the 1990's. The attractive conditions in Malaysia, reportedly, included a higher success rate, good geology, shallow waters, large and virtually untouched tracts that could be developed at low cost, and political stability.[57]

PHILIPPINES[58]

The country's real GDP increased by an estimated 6.7% over that of 1987, the second successive year of real growth, recovering to the precrisis level. The minerals industry represented an estimated 2% of the GDP.

The mining industry underwent a critical change during the year because many of the nation's leading producers attempted to cash in on strong base-metal prices, especially copper. However, for many, recovery was threatened by a Government decision to abandon the scheme introduced in 1984 that allowed financially distressed copper companies to defer all taxes and other levies when metal prices slumped. The copper mining firms of Atlas Consolidated Mining and Development Corp., Marcopper Mining Corp., Maricalum Mining Corp., and North Davao Mining Corp. were the major companies

whose taxes had been deferred. The Government's decision required not only that current taxes and levies be paid because of healthy financial turnarounds by these companies, as under the original concept, but also required the repayment of taxes in arrears. This would affect the essential expansion programs and capital projects of the companies, which had suffered because of profitability losses and working capital deficits, by drawing off funds to service the large tax bills.

The Philippines is rich in mineral resources. There are large deposits of copper, chromium, gold, and nickel. Others included cadmium, iron ore, lead, manganese, mercury, molybdenum, and silver; the industrial minerals asbestos, gypsum, limestone, marble, phosphate rock, salt, and sulfur; and the mineral fuels asphalt, coal, and petroleum. The Philippines was among the top 10 world producers of chromium, ranking 6th in 1988; copper, 10th; and gold, 9th. It was an important regional producer of other commodities. Copper and gold remained the country's most important mineral products.

Government Policies and Programs

The bright outlook for the Philippine mining industry was expected to be enhanced by the approval of a new mining code by the Congress. Mining legislation, led primarily by the Chamber of Mines of the Philippines, was being drafted during the year. This legislation would include the model agreements covering exploration, development, and use of minerals mandated in the 1987 Constitution. The objectives of the new code were to provide (1) legal stability and predictability of mining tenure, (2) a fair return on mining investments, and (3) a reasonable mineral tax regime.

The first objective, stability and predictability, would be assured by the use of agreements governing exploration, development, and actual mining. The agreements would be guaranteed against alteration whether by rules and regulations or by legislation. The second objective, equitable profits, would be negotiated between the Government and the large U.S. minerals producer Freeport-McMoRan Inc. to establish guidelines for domestic and foreign mining companies. Reasonable taxation, the third objective of the code, would convince the Government to align mining taxes with those of its Southeast Asian neighbors so as to be competitive with them, to encourage new investments, and to promote the growth of the mining industry.

The drafting of the new mining code was constrained by the provisions in the Constitution, which ordain that minerals are owned by the state.

Production

The value of production of the Philippines mining industry was estimated to be $1.11 billion[59] during 1988, an increase of about 20% over that of the previous year. The increase was primarily due to strong prices for copper, gold, and nickel in the world market. Gold contributed the largest share with about $500 million, followed by copper with about $365 million.

Trade

Mineral exports, which were estimated at $760 million, were 64% more than in 1987 and contributed 11% to the total export earnings of the country. Copper and gold shipments, primarily to China, Japan, and the Republic of Korea, accounted for 82% of total mineral exports. However, about 20% of total export earnings, $148 million, was spent on mineral imports.

Most of the minerals produced in the country were for export, usually in an upgraded form rather than as ore, in order to increase their value and reduce shipping costs. Japan and the United States were the major trading partners of the Philippines.

The country continued to depend on imports for its supplies of iron ore and concentrate, crude fertilizer, and high-thermal coal.

Commodity Review

Metals.—**Chromium.**—The Benguet Corp. planned a small-scale chromite project in Palawan for startup in 1989 at a target rate of 1,000 tons of metallurgical chromite per month.

Copper.—The Bond Corp. of Australia offered a proposal at yearend 1987 to Atlas Consolidated, not only the largest copper producer in the Philippines but also thought to have the largest reserves of copper ore in the country. Atlas rejected the proposal in August. The proposal would have given the Bond Corp. a stake in the Masbate gold mine on Masbate Island in return for a debt reduction scheme.

At its Toledo Mine on Cebu Island, Atlas Consolidated installed a belt conveyor that was estimated to have reduced ore hauling costs from the high-grade underground section to the Carmen concentrator by 45%. The company also expanded underground operations to the south, beneath the Ilag River, where reserves of 78 million tons had been defined. A second open pit was planned, at an estimated cost of $41.3 million, to offset nearly depleted ore reserves at the existing Toledo Mine.

On April 15, the Government ordered the closing of Marcopper's Tapian Mine and mill at Santa Cruz on Marinduque Island until a new tailings disposal system could be installed to handle the discharge of 28,000 tons of tailings per day. The Department of Environment, Energy and Natural Resources Pollution Adjudication Board ordered the closure because toxic mine tailings had been discharged into Calancan Bay off Marinduque Island. The mill produced about 300 tons of copper concentrate per day. Marcopper, the country's third largest copper producer, lost an estimated $175,000 per day while the mill was shut down from April 19 to May 14. The new discharge system was planned to dispose of the tailings deeper and further

TABLE 15

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]	1984	1985	1986	1987[p]	1988[e]
METALS					
Arsenic: White (equivalent of arsenic acid)[e]	—	5,000	5,000	5,000	5,000
Chromium: Chromite, gross weight:					
Metallurgical-grade	123,015	122,359	85,271	69,429	70,000
Chemical-grade	5,369	15,038	16,109	19,899	20,000
Refractory-grade	132,505	134,634	72,850	98,572	100,000
Total	**260,889**	**272,031**	**174,230**	**187,900**	**190,000**
Cobalt, mine output, Co content	64	911	92	—	—
Copper:					
Mine output, Cu content	233,359	222,189	222,644	216,145	[3]218,090
Metal:					
Smelter	109,200	133,800	124,300	124,700	125,000
Refined	99,230	130,227	134,547	132,118	[3]132,183
Gold, mine output, Au content troy ounces	827,149	1,062,997	1,154,917	1,048,081	[3]1,044,448
Iron and steel:					
Ferroalloys:					
Electric-furnace ferrosilicon[e]	18,500	20,000	20,000	—	—
Electric-furnace ferrochromium	48,049	50,815	[e]55,000	—	—
Steel, crude thousand tons	250	250	[e]250	[e]250	250
Manganese ore and concentrate, gross weight	615	387	232	421	[3]670
Nickel:					
Mine output, Ni content	13,601	28,158	12,790	7,818	10,800
Metal, smelter	3,528	16,993	2,076	—	—
Silver, mine output, Ag content thousand troy ounces	1,574	1,685	1,688	1,684	[3]1,662
Zinc, mine output, Zn content	2,189	1,880	1,573	1,129	[3]1,435
INDUSTRIAL MINERALS					
Barite	581	—	—	—	—
Cement, hydraulic thousand tons	3,651	3,080	3,547	3,320	[3]4,300
Clays:					
Bentonite	38,249	24,971	1,800	759	[3]2,030
Red	200	—	350	[e]300	300
White	8,618	6,093	16,784	[e]7,000	10,000
Other	372,111	344,921	366,753	406,033	400,000
Feldspar	11,486	5,412	6,661	[e]6,000	6,000
Gypsum and anhydrite:					
Natural	600	300	13,080	13,233	13,000
Synthetic[e]	112,000	112,000	112,000	[e]112,000	115,000
Lime	50,711	47,427	38,110	[e]45,000	40,000
Magnesite	625	676	[e]650	[e]650	650
Nitrogen: N content of ammonia	16,200	[e]17,000	[e]17,000	—	—
Perlite	5,641	3,883	[e]3,500	[e]4,000	4,000

See footnotes at end of table.

TABLE 15—Continued

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Phosphate:						
Guano		552	1,229	3,466	e1,000	1,000
Phosphate rock		7,488	6,392	1,656	e8,000	8,000
Pyrite and pyrrhotite (including cuprous), gross weight		82,806	232,478	244,028	341,417	300,000
Salt, marine		401,008	421,058	785,354	446,532	500,000
Sand and gravel:						
Silica sand	thousand tons	432	317	259	213	[3]177
Other[4]	thousand cubic meters	14,695	11,235	11,525	13,943	15,000
Stone:						
Dolomite		368,052	362,101	281,346	e360,000	350,000
Limestone[5]	thousand tons	4,074	3,521	4,328	4,022	4,000
Marble (dimension), unfinished	cubic meters	4,919	4,010	7,586	5,000	5,000
Volcanic cinder	do.	—	6,630	e1,000	1,000	1,500
Sandstone		5,340	—	—	—	—
Tuff		29,269	19,505	e20,000	—	—
Quartz		79,536	93,735	46,972	80,000	75,000
Crushed, broken, other[6]	thousand cubic meters	600	701	599	1,000	1,000
Sulfur: S content of pyrite		38,505	108,102	113,473	158,179	160,000
Talc		927	345	e1,000	—	—
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades		1,216,388	1,257,881	1,128,449	1,152,342	[3]1,330,000
Petroleum:						
Crude	thousand 42-gallon barrels	3,890	3,285	2,190	1,800	[3]2,170
Refinery products:						
Gasoline	do.	8,124	e9,000	e9,200	e9,000	9,000
Jet fuel	do.	3,322	e3,000	e3,000	e3,000	3,000
Kerosene	do.	2,382	e2,500	e2,700	e2,500	2,500
Distillate fuel oil	do.	17,027	e17,000	e17,300	e17,000	17,000
Residual fuel oil	do.	18,544	e19,000	e20,000	e19,000	19,000
Other	do.	5,027	e4,500	e4,800	e4,500	4,500
Refinery fuel and losses	do.	e15,000	e15,000	e15,000	e15,000	15,000
Total	**do.**	**e68,426**	**e70,000**	**e72,000**	**e70,000**	**70,000**

[e] Estimated. [p] Preliminary.

[1] Table includes data available through July 11, 1989.

[2] In addition to the commodities listed, the Philippines produces platinum-group metals as byproducts of other metals, but output is not reported quantitatively, and no basis is available to make reliable estimates of output levels.

[3] Reported figure.

[4] Includes "pebbles" and "soil" not further described.

[5] Excludes limestone for road construction.

[6] Includes materials described as rock, crushed or broken; stones, cobbles, and boulders; rock aggregates; and broken adobe.

TABLE 16

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	44	59	12	Japan 47.
Semimanufactures	12	47	—	Hong Kong 40; Thailand 3.
Chromium: Ore and concentrate	130,165	105,676	13,656	Sweden 25,990; West Germany 16,007.
Copper:				
Ore and concentrate	359,781	361,952	—	Japan 361,952; China 27,608.
Metal including alloys:				
Scrap	8,151	8,150	—	Singapore 6,000; Japan 1,648.
Unwrought	130,228	106,530	—	Japan 46,861; Taiwan 36,742; Republic of Korea 17,500.
Semimanufactures	5,235	3,607	163	Taiwan 1,255; Japan 751.
Gold:				
Contained in copper concentrates troy ounces	394,572	212,068	—	Japan 192,331; Republic of Korea 10,810.
Waste and sweepings do.	—	19	—	All to Hong Kong.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite:				
Agglomerated thousand tons	3,587	4,017	—	All to Japan.
Not agglomerated	16,552	—		
Pyrite, roasted	7,917	10,408	—	Republic of Korea 9,841; Japan 567.
Metal:				
Scrap	849	1,313	—	Japan 1,002; Taiwan 238.
Ferroalloys:				
Ferrosilicon	10,079	10,225	18	Japan 3,926; Republic of Korea 3,072.
Unspecified	55,970	50,820	—	Japan 46,310; Republic of Korea 3,152.
Semimanufactures:				
Bars, rods, angles, shapes, sections	110	109	1	Australia 95.
Universals, plates, sheets	16	82	—	Thailand 59; Guam 13.
Wire	7	3	—	All to Pacific Islands Trust Territory.
Tubes, pipes, fittings	525	1,608	1,252	Hong Kong 194; Indonesia 78.
Castings and forgings, rough	408	528	213	Australia 296.
Lead: Metal including alloys:				
Scrap	—	3	3	
Semimanufactures kilograms	95	—		
Magnesium: Metal including alloys, scrap	10	6	—	All to Japan.
Manganese: Ore and concentrate:				
Metallurgical-grade	216	20	—	Do.
Nickel:				
Ore and concentrate	420,809	483,417	—	Do.

See footnotes at end of table.

TABLE 16—Continued

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Nickel—Continued				
Metal including alloys:				
Scrap	—	36	—	All to Netherlands.
Unwrought	2,566	—		
Semimanufactures	1,604	—		
Silver:				
Waste and sweepings[2] kilograms	428	5,397	—	All to Hong Kong.
Metal including alloys, unwrought and partly wrought troy ounces	708,034	157,627	12,286	France 58,958; Hong Kong 31,159.
Tin:				
Ore and concentrate	—	1	—	All to Singapore.
Metal including alloys:				
Scrap	15	34	3	Singapore 20; Japan 10.
Semimanufactures	—	16	—	All to Singapore.
Titanium: Oxides kilograms	—	553	—	Republic of Korea 326; Taiwan 227.
Tungsten: Metal including alloys, scrap	4	—		
Zinc:				
Ore and concentrate	3,404	2,128	—	All to Japan.
Metal including alloys:				
Scrap	304	495	—	Japan 306; Taiwan 189.
Semimanufactures	—	1	—	All to Australia.
Other:				
Oxides and hydroxides	r110	134	21	Netherlands 54; United Kingdom 28.
Ashes and residues	8,467	22,881	—	Singapore 20,209; Japan 1,479.
Base metals including alloys, all forms	688	1,364	339	Japan 249; Australia 234.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	634	1,563	—	Hong Kong 704; Taiwan 629; Republic of Korea 135.
Grinding and polishing wheels and stones kilograms	—	15	15	
Asbestos, crude	360	—		
Cement	105,366	38,552	—	Bangladesh 26,642; Vietnam 11,900.
Clays, crude	10	—		
Diamond: Industrial stones carats	—	4,270	—	All to Singapore.
Feldspar, fluorspar, related materials	—	16,419	—	All to Taiwan.
Fertilizer materials:				
Crude, n.e.s.	1,173	3,124	—	Taiwan 1,772; Japan 1,301.
Manufactured:				
Nitrogenous	13,790	36,279	—	Australia 17,488; Thailand 15,740.
Phosphatic	544,503	321,068	—	China 162,666; Thailand 105,352.
Unspecified and mixed	30,614	181,850	—	China 158,299; Iran 15,750.

See footnotes at end of table

TABLE 16—Continued

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	5,250	61,227	—	All to Japan.
Lime	12	—		
Magnesium compounds: Magnesite, crude	—	80	—	All to Taiwan.
Mica: Crude including splittings and waste kilograms	500	—		
Phosphates, crude	600	700	—	Do.
Pigments, mineral: Natural crude	1	1	—	All to Guam.
Pyrite, unroasted	—	54	—	All to Japan.
Salt and brine	1	6	1	Pacific Islands Trust Territory 5.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	4,094	7,323	17	Taiwan 3,737; Japan 3,464.
Worked	2,136	5,345	1,850	Japan 2,227; Australia 471.
Dolomite, chiefly refractory-grade	271,247	215,721	—	Japan 212,721; Malaysia 3,000.
Gravel and crushed rock	15,114	24,399	7	Japan 16,336; Hong Kong 3,263.
Limestone other than dimension	39,954	175,882	—	Taiwan 141,904; Japan 32,774.
Quartz and quartzite	—	2	—	All to Australia.
Sand other than metal-bearing	2,668	3,455	920	Japan 1,260; United Kingdom 359.
Sulfur:				
Elemental: Colloidal, precipitated, sublimed kilograms	20	—		
Sulfuric acid do.	—	90	—	All to Malaysia.
Other				
Crude	2,198	6,222	—	Republic of Korea 4,037; Taiwan 1,940.
Slag and dross, not metal-bearing	480	—		
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	18	14	—	All to Hong Kong.
Carbon black	1,477	575	—	Thailand 352; Taiwan 183.
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	868	1,362	—	Hong Kong 861; India 152; Thailand 123.
Gasoline:				
Aviation do.	—	10	10	
Motor do.	—	332	187	Japan 90; Thailand 47.
Naphtha do.	1,864	2,229	—	Japan 687; Taiwan 549; Malaysia 444.
Mineral jelly and wax do.	—	(3)	—	All to Australia.
Kerosene and jet fuel do.	336	291	—	Malaysia 223; Thailand 65.
Distillate fuel oil do.	—	606	—	Malaysia 402; Thailand 132.
Lubricants do.	10	17	—	Taiwan 11.
Residual fuel oil do.	442	34	—	Thailand 18; Nauru 16.
Bitumen and other residues do.	(3)	(3)	—	All to Hong Kong.

r Revised.
[1] Table prepared by Audrey D. Wilkes.
[2] May include other precious metals.
[3] Less than 1/2 unit.

TABLE 17

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	2	79	(2)	China 75.
Aluminum:				
Ore and concentrate	5,379	933	—	China 650; United Kingdom 206.
Oxides and hydroxides	5,380	8,257	85	Japan 5,742; Singapore 996.
Metal including alloys:				
Scrap	345	793	5	Hong Kong 578; Abu Dhabi 200.
Unwrought	6,271	10,808	—	Australia 6,953; Norway 1,134; France 981.
Semimanufactures	6,445	11,038	299	Republic of Korea 3,910; Japan 2,750.
Arsenic: Oxides and acids	16	52	—	Malaysia 46; United Kingdom 4.
Chromium:				
Ore and concentrate	17	12,000	—	All from India.
Oxides and hydroxides	27	93	18	West Germany 40; Japan 20.
Cobalt: Oxides and hydroxides kilograms	1,231	2,104	—	Hong Kong 2,000; Taiwan 54.
Copper:				
Ore and concentrate	—	22,005	—	All from Papua New Guinea.
Sulfate	245	135	(2)	Taiwan 49; Bulgaria 40; West Germany 26.
Metal including alloys:				
Scrap	16	2	—	All from Hong Kong.
Unwrought	8	543	5	Singapore 370; Indonesia 147.
Semimanufactures	3,241	4,540	365	Japan 2,380; Republic of Korea 449.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	9,571	3,315	866	Singapore 1,339; Republic of Korea 922.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite, not agglomerated thousand tons	2,575	3,483	—	Brazil 1,558; Australia 1,471; Canada 454.
Metal:				
Scrap	85,243	108,994	80,664	Netherlands 22,357; Australia 5,358.
Pig iron, cast iron, related materials	22,366	70,612	1	Malaysia 61,023; China 8,802.
Ferroalloys:				
Ferromanganese	1,431	2,297	—	France 532; Mozambique 316; China 240.
Ferrosilicon	108	554	—	China 465; United Kingdom 43.
Unspecified	184	563	2	Brazil 411; Japan 58.
Steel, primary forms	391,367	639,280	31,210	Brazil 205,036; Australia 78,455.
Semimanufactures:				
Bars, rods, angles, shapes, sections	37,685	79,718	1,078	Japan 20,601; Malaysia 12,200.
Universals, plates, sheets	199,923	358,779	5,013	Japan 172,232; Mozambique 41,793.
Hoop and strip	4,495	4,483	208	Japan 2,749; Singapore 352.
Rails and accessories	384	557	1	Republic of Korea 308; Japan 190.
Wire	7,128	10,785	73	Republic of Korea 4,176; Japan 3,140.
Tubes, pipes, fittings	12,445	20,614	389	Japan 7,553; West Germany 5,266.
Castings and forgings, rough kilograms	—	189	—	All from Taiwan.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Lead:				
Oxides	12	27	(2)	Australia 22; Japan 4.
Metal including alloys:				
Scrap	4,307	9,069	—	Australia 6,759; Singapore 2,249.
Unwrought	4,532	8,739	164	Australia 3,696; Taiwan 2,874.
Semimanufactures	197	447	5	Australia 295; Japan 128.
Magnesium: Metal including alloys, all forms	36	3	—	Japan 2; United Kingdom 1.
Manganese:				
Ore and concentrate: Metallurgical-grade	3,040	3,594	(2)	Singapore 2,564; Japan 938.
Oxides	874	1,142	(2)	Japan 932; Australia 70.
Mercury 76-pound flasks	1,596	1,914	(2)	China 1,379; Hong Kong 271.
Molybdenum: Metal including alloys, all forms	2	4	2	Belgium-Luxembourg 1.
Nickel:				
Metal including alloys:				
Unwrought	50	91	12	Singapore 19; Canada 15.
Semimanufactures	68	91	3	Japan 49; West Germany 15.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	387	—		
Silver: Metal including alloys, unwrought and partly wrought do.	885	210	37	West Germany 161.
Tin: Metal including alloys:				
Scrap	—	5	5	
Unwrought	465	797	2	Indonesia 668; Malaysia 89.
Semimanufactures	62	3	—	China 2.
Titanium:				
Ore and concentrate	966	1,305	—	Australia 1,169; Republic of Korea 60.
Oxides	1,505	1,679	119	Japan 521; Australia 385.
Tungsten: Metal including alloys, all forms	8	82	(2)	Australia 77.
Uranium and/or thorium: Oxides and other compounds kilograms	—	60	—	All from Japan.
Zinc:				
Oxides	r377	700	11	Republic of Korea 366; China 92; Taiwan 65.
Blue powder	168	—		
Metal including alloys:				
Scrap	—	60	—	All from Taiwan.
Unwrought	18,897	21,376	150	Australia 7,937; China 4,152.
Semimanufactures	27	446	235	Taiwan 112; Italy 35.
Zirconium: Ore and concentrate	41	48	—	Australia 41.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Other:				
Ores and concentrates	7	3	—	All from Japan.
Oxides and hydroxides	5,386	5,253	—	Belgium-Luxembourg 3,216; China 1,079.
Ashes and residues	38,535	66,740	267	Japan 66,353.
Base metals including alloys, all forms	30	151	42	Hong Kong 48; China 30.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	244	611	20	Hong Kong 190; China 180; Netherlands 148.
Artificial:				
Corundum	63	21	—	Austria 18; Japan 2.
Silicon carbide	51	37	5	Hong Kong 23; Brazil 7.
Dust and powder of precious and semiprecious stones including diamond grams	150	—		
Grinding and polishing wheels and stones	788	1,336	270	Republic of Korea 327; Hong Kong 181.
Asbestos, crude	1,151	1,911	202	Canada 1,165; U.S.S.R. 425.
Barite and witherite	43	2,257	21	Thailand 1,265; Singapore 436.
Boron materials: Oxides and acids	174	300	97	France 130; Italy 72.
Bromine including fluorine and iodine	4	6	2	West Germany 3.
Cement	14,033	289,182	2,603	Republic of Korea 131,248; Indonesia 87,000.
Chalk	24	86	—	West Germany 64; Taiwan 22.
Clays, crude	19,291	26,816	9,131	Indonesia 3,694; Malaysia 2,016.
Cryolite and chiolite kilograms	500	—		
Diamond: Industrial stones:				
Natural carats	1,067,311	226,862	—	Belgium-Luxembourg 89,187; Ireland 54,150; Italy 50,000.
Synthetic do.	—	4,700	—	All from Australia.
Diatomite and other infusorial earth	407	796	236	Taiwan 264; Japan 224.
Feldspar, fluorspar, related materials	1,535	6,516	49	Thailand 4,147; India 674.
Fertilizer materials:				
Crude, n.e.s.	12	—		
Manufactured:				
Ammonia	139,254	166,370	3,469	Indonesia 103,623; Qatar 18,052; Kuwait 15,018.
Nitrogenous	720,402	792,751	52,198	Indonesia 136,288; Kuwait 112,574.
Phosphatic	760	6,056	1,140	Japan 4,432.
Potassic	86,590	170,137	10,902	Canada 66,875; Israel 33,000.
Unspecified and mixed	52,860	951	18	Norway 390; Japan 238.
Graphite, natural	122	365	1	Republic of Korea 177; China 125.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	150,984	127,902	406	Japan 68,764; Indonesia 35,378.
Lime	431	90	—	United Kingdom 55; Taiwan 35.
Magnesium compounds: Magnesite, crude and calcined	8,375	29,268	11	Republic of Korea 19,732; China 4,920.
Mica:				
Crude including splittings and waste	109	134	48	China 22; Malaysia 18.
Worked including agglomerated splittings	3	21	9	Belgium-Luxembourg 6; Japan 3.
Nitrates, crude	74	98	—	Belgium-Luxembourg 60; Netherlands 20; West Germany 18.
Phosphates, crude thousand tons	1,287	1,035	—	Morocco 529; Senegal 352; Nauru 68.
Pigments, mineral:				
Natural, crude	3,106	3,491	73	India 2,808; United Kingdom 481.
Iron oxides and hydroxides, processed	871	1,269	110	West Germany 722; Spain 251.
Salt and brine	88,917	93,053	28	Australia 50,878; China 31,629.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	71,229	115,432	50,792	Kenya 36,257; Japan 27,069.
Sulfate, manufactured	14,730	14,271	73	China 11,557; Hong Kong 2,096.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	154	810	—	Italy 415; China 228.
Worked	16	109	—	Spain 55; Hong Kong 42.
Dolomite, chiefly refractory-grade	1,271	1,488	—	United Kingdom 1,176; Thailand 163.
Gravel and crushed rock	214	173	—	France 134; Belgium-Luxembourg 20.
Limestone other than dimension	1,695	6,453	—	Taiwan 6,149; Japan 214.
Quartz and quartzite	2	113	6	China 81; Italy 6.
Sand other than metal-bearing	11,689	740	103	Taiwan 592.
Sulfur:				
Elemental:				
Crude including native and byproduct	2,015	17,233	163	Singapore 8,916; Canada 5,518.
Colloidal, precipitated, sublimed	17,318	1,704	15	Singapore 1,027; Taiwan 234.
Dioxide	1	2	(2)	Mainly from Netherlands.
Sulfuric acid	123,407	138,679	16	Japan 138,633.
Talc, steatite, soapstone, pyrophyllite	7,147	8,464	462	Republic of Korea 4,558; China 2,284.
Other:				
Crude	359	638	1	Australia 346; Japan 259.
Slag and dross, not metal-bearing	80,017	155,074	1	Chile 64,292; Taiwan 44,411.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	50	29	—	Singapore 28.
Carbon black	764	2,366	1,580	Taiwan 419; Australia 99.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal, all grades including briquets		960,308	480,048	42	Australia 338,612; China 110,788.
Coke and semicoke		85,134	80,379	1	Japan 77,277; Australia 3,096.
Petroleum:					
Crude	thousand 42-gallon barrels	49,391	62,471	—	Kuwait 15,324; Saudi Arabia 10,877; Malaysia 8,884.
Refinery products:					
Liquefied petroleum gas	do.	655	1,759	—	Saudi Arabia 634; Kuwait 473; Bahrain 371.
Gasoline	do.	25	122	1	Singapore 94; Australia 26.
Mineral jelly and wax	do.	54	76	7	China 55; Hong Kong 5.
Kerosene and jet fuel	do.	(2)	(2)	—	All from Japan.
Distillate fuel oil	do.	6,285	8,593	—	Kuwait 3,364; Singapore 3,132; Taiwan 1,030.
Lubricants	do.	46	117	24	Japan 35; Taiwan 15.
Residual fuel oil	do.	13	145	—	Singapore 118; Australia 27.
Bitumen and other residues	do.	(2)	(2)	—	All from Japan.
Bituminous mixtures	do.	(2)	(2)	(2)	Mainly from West Germany.

[r] Revised.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.

out to sea, thus eliminating or at least reducing environmental damage to reefs and sea life.

After reopening the Tapian Mine, Marcopper announced plans to restart development at its San Antonio ore body 3 kilometers from the Tapian facility. Its earlier development stopped in 1983 when copper prices plunged to unprofitable levels. The San Antonio deposit reportedly contains an estimated 200 million tons of reserves grading 0.47% copper, which will be mined by open pit methods similar to those used at Tapian. The production rate was also expected to be similar.[60] Reserves at Tapian were expected to be exhausted in 1989.

Marcopper returned to making a profit in the first quarter after sustaining severe losses since 1984. The better performance was attributed to higher metal prices, lower production costs, and a favorable exchange rate. However, this performance was not expected to continue because the San Antonio project needed Government tax concessions, an agreement with lenders to restructure their defaulted loans, $50 million in new financing, and a Government permit to use the Tapian mill's disposal system. Marcopper stated that even if the Government agreed to all this, it would still take 6 years to complete the San Antonio project. Although production could begin in 3 years, there would be a break in mining of at least 18 months.[61] The Government owned a 49% share of the company.

The Philex Mining Corp. completed its $14.8 million expansion program at the Santo Tomas Mine at Tuba, Benguet Province, during the second quarter, thereby increasing its mining and milling capacity by 14% to 32,000 tons of ore per day. The expansion enabled Philex to mine richer ore and transport it to the concentrator via a cable belt at a rate of 1,800 tons per hour through a 2,500-meter inclined tunnel.

A joint-venture company, Far South East Gold Resources Inc., was formed in July by Lepanto Consolidated Mining Co. Inc, 60%; Canada's Galactic Resources Ltd., 30%; and the World Bank's International Finance Corp. (IFC), 10%. Far South East planned to develop an underground copper-gold mine at Mankayan in Benguet Province. Reserves in the Far South East porphyry deposit were estimated at 163 million tons of ore grading 0.81% copper. The mine life was projected to be 11 years, producing an average of about 32,000 tons of copper per year. (See the Gold section for additional

information.)

The Philippine Associated Smelting and Refining Corp. (PASAR) was owned by the state-owned National Development Corp., 40%; a Japanese consortium led by Marubeni Corp., 32%; local copper producers led by Atlas Consolidated, 23%; and IFC, 5%. PASAR planned to increase production by 25% at its 138,000-ton-per-year smelter at Isabel in the central Province of Leyte. The expansion was expected to cost $51 million and to be financed partly by the Japanese Government.[62] A feasibility study conducted by PASAR indicated that project costs could be recovered within 2 years. Expansion of the smelter would mean importing copper concentrates to compensate for the limited supplies from local producers.

The Philippines ranked 10th among world copper producers. According to the Chamber of Mines of the Philippines, production of copper, by company, is shown in the text table in metric tons.[63]

Company	1987	1988
Atlas Consolidated Mining and Development Corp.	81,049	85,356
Maricalum Mining Corp.	40,606	38,711
Marcopper Mining Corp.	23,933	26,571
Philex Mining Corp.	23,618	21,912
Benguet Corp.	19,153	20,976
Lepanto Consolidated Mining Co. Inc.	r14,116	13,157
North Davao Mining Corp.	13,671	11,406
Total	**r215,015**	**218,089**

r Revised.

Gold.—The country's largest gold producer, Benguet, planned to extend the remaining life of the Dizon Mine, 50% owned by Dizon Copper-Silver Mines Inc. at San Marcelino, Zambales Province, by mining deep-seated ores. Benguet expected the mining of these ores would increase the reserves from 21 million tons of ore to 61 million tons of ore and would extend the mine life from 6 to 9 years. The projected cost of the project was $24 million.

Benguet began a feasibility study for switching from underground to surface mining at its Antamok Mine, 20 kilometers from Baguio, Benguet Province. If feasible, the mine would have a mine life of 13 years and would be in production by 1991 at the rate of 100,000 ounces of gold per year.

Benguet Exploration Inc. awarded a contract to Australia's BHP Engineering Ltd. to conduct a feasibility study for a gold-tailings-treatment plant to be located in Boringot, Davao del Norte Province. The plant was to be designed to treat the tailings of small-scale mines operating in the area and would use the carbon-in-pulp and carbon-in-leach processes.

Itogon-Suyoc Mines Inc., 54% owned by Benguet, planned to expand operations at its Itogon underground mine at Itogon, Benguet Province, in 1989.

At its gold-silver project at Aroroy on Masbate Island, Atlas Consolidated conducted accelerated exploration at five main pre-World War II workings, resulting in the expectation that the old Dabu-Panique Mine would come onstream early in 1989. Two other underground operations in the area were also expected to begin production to help replace depleted near-surface reserves at the Masbate open pit operation.

Far South East Gold Resources Inc. was formed to develop a mine in Benguet Province. Ore reserves were estimated at 163 million tons of ore grading 1.76 grams of gold per ton. An average of 250,000 ounces of gold per year was expected to be produced over the life of the mine, the largest single gold project in the history of the Philippines.[64] (See the Copper section for additional information.)

Cultus Gold NL of Australia and its Philippine affiliate, Alpha Resources Development Corp., identified a low-grade, bulk-tonnage, epithermal gold deposit in Camarines Norte in midyear and further explored the prospect.

Cultus Gold was awarded a contract at yearend by the Government to reprocess an estimated 10 million tons of tailings, with a potential grade of 0.5 to 1.5 grams of gold per ton at the former Philippine Iron Mines at Larap, 185 kilometers southeast of Manila. The mines were closed in 1974. Cultus Gold planned an evaluation program for the first half of 1989 to determine the volume and grade of the tailings, which were derived from processing magnetite from the mines. Under the terms of the contract, Cultus Gold was awarded right of possession for reprocessing in return for a 6% gross revenue royalty.[65]

Banahaw Mining and Development Corp., owned by Muswellbrook Energy and Minerals Pty. Ltd. of Australia and their Philippine partners, awarded a contract at yearend for the design and management of the plant at a project in Agusan del Sur on Mindanao Island. The plant was expected to treat 180,000 tons of ore per year to recover 30,000 ounces of gold. A batch carbon-in-pulp plant had been operating at the site.

Dublin-based Kenmare Resources PLC signed an agreement with Government-owned Planters Products Ltd. to heap leach a gold tailings deposit near Manila. The deposit was estimated to contain 240,000 tons of material. Test work began in August, and, should results be positive, leaching was scheduled to begin early in 1989.

Gold production in the Philippines was ranked ninth in the world in 1983. According to the Chamber of Mines of the Philippines, gold production by companies and small-scale gold panners is shown in the text table, in troy ounces.[66]

Company	1987	1988
Benguet Corp. (primary and by product)	249,137	275,302
Atlas Consolidated Mining and Development Corp. (primary and byproduct)	139,846	143,640
Philex Mining Corp. (byproduct)	158,068	137,890

Company	1987	1988
Lepanto Consolidated Mining Co. Inc. (byproduct)	73,373	82,670
Surigao Consolidated Mining Co. (primary)	39,596	33,428
Apex Mining Co. Inc. (primary)	44,952	27,580
Marcopper Mining Corp. (byproduct)	19,091	18,632
Itogon-Suyoc Mines Inc. (primary)	11,115	13,479
Manila Mining Corp. (primary)	8,086	9,770
Benguet Exploration Inc. (primary and byproduct)	11,368	9,685
Maricalum Mining Corp. (byproduct)	9,267	9,252
North Davao Mining Corp. (byproduct)	9,212	7,338
Small-scale gold panners[e]	500,000	500,000
Total[e]	**1,273,111**	**1,268,666**

[e] Estimated

Nickel.—The Asset Privatization Trust (APT), a Government-formed body, oversees assets foreclosed by the Development Bank of the Philippines and the Philippines National Bank. APT evaluated three offers to operate the Nonoc Mining and Industrial Corp.'s (NMIC) nickel production facilities on Nonoc Island (mine) and Marinduque Island (refinery) in Surigao del Norte Province. The facilities were mothballed in March 1986 after financial and labor difficulties. The mine had proven reserves of about 100 million tons of lateritic ore, sufficient for a mine life of about 31 years. The refinery had a rated nickel capacity of 30,000 tons per year, and it also produced 1,500 tons of cobalt per year. Bringing the refinery back on-stream will cost an estimated $70 million to $80 million for rehabilitation and extensive modernization, but this was considered cheaper than constructing a new plant. However, none of the offers was accepted, and APT decided near yearend to auction off the facilities instead. APT set the minimum acceptable bid at $300 million.[67] Several groups reportedly expressed an interest in NMIC at yearend. They included Dallhold Nickel Management Pty. Ltd., a wholly owned Bond Corp. subsidiary, and the U.S.S.R., which was known to be interested in processing technology for lateritic nickel ores and in obtaining more cobalt.

Steel.—National Steel Corp. purchased a 1 million-ton-per-year hot strip mill formerly installed at Wheeling-Pittsburgh Steel Co.'s Allenport, PA, steelworks for its Iligan steelworks, Misamis Oriental Province. The new mill was part of National's $230 million second-phase expansion and modernization program, which also included increasing capacity of its downstream cold mill and tinning lines. Flat product output was aimed to reach 1.2 million tons in 1992 and the expanded cold mill was expected to start operations in 1991.

***Industrial Minerals.*—Sulfur.**—Freeport-McMoRan Inc. of the United States negotiated with the Government a production-sharing agreement concerning a sulfur deposit owned by Pampelone Sulphur Mining Corp. The 20-million-ton, low-grade deposit was formerly examined by Benguet, which conducted drilling programs and constructed some buildings, but did not develop the deposit further. Freeport's interest stemmed from examination of these earlier drilling results, and the company saw a potential source of sulfur for serving the Pacific Rim fertilizer markets. Further progress was dependent upon the outcome of Government negotiations, because an agreement had been made with Pampelone Sulphur.

***Mineral Fuels.*—Petroleum.**—The Committee for Coordination of Joint Prospecting of Mineral Resources in Asian Offshore Areas (CCOP) assisted in the exploration of the first offshore oilfield in Palawan. CCDP agreed late in the year to help expand exploration for oil in Philippine offshore areas in order to reduce the dependence of the country on imported oil. CCOP was organized in 1966 to promote and coordinate joint prospecting and research in offshore areas in the Asian region.

SINGAPORE[68]

Singapore's GDP rose by 10.9% in 1988 with broad-based growth except for financial and business services. Strong external demand contributed 88% to the growth in demand. The country's exports of goods and services grew by 28% compared with 11% in 1987. Nonoil domestic exports and reexports increased by 41% and 39%, respectively. In the manufacturing sector, such as the electronics industry, the growth rate slowed down in the last quarter of 1988. The petroleum industry was also declining because of a reduction in sales to Japan and a fall in crude oil processing volumes from China. Investment in the country reached $1.03 billion[69] in 1988, the highest level in the decade.

The labor productivity level in the manufacturing sector varied among the top 10 industries. The chemical and gas industry was the highest in value added output (defined as the total value of output minus the cost of raw material inputs) per worker. The chemical and gas industry, with an output of $4.6 billion, achieved rapid growth at 28% and was more profitable. A modern $390 million titanium dioxide plant, funded by investments from Japan's Ishihara Sangyo Kaisha (ISK), was to be operational at Tuas in 1989 in order to cater to regional (60%) and worldwide (40%) markets. The first-phase facility, costing about $200 million, had a production capacity of 36,000 tons per year. When the second-phase facility is completed, the plant capacity

TABLE 18

SINGAPORE: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Cement, hydraulic	thousand tons	2,821	1,992	1,805	1,527	1,595
Iron and steel: Metal: Steel, crude[e]	do.	350	350	350	350	300
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	17,731	[e]18,000	[e]18,000	[e]19,000	[e]19,000
Jet fuel	do.	43,578	[e]44,000	[e]44,000	[e]44,000	[e]45,000
Kerosene	do.	14,338	[e]14,000	[e]13,000	[e]13,000	[e]12,000
Distillate fuel oil	do.	76,677	[e]77,000	[e]75,000	[e]72,000	[e]72,000
Residual fuel oil	do.	87,418	[e]87,000	[e]85,000	[e]82,000	[e]82,000
Lubricants	do.	3,959	[e]4,000	[e]4,000	[e]4,000	[e]5,000
Other	do.	45,560	[e]46,000	[e]45,000	[e]45,000	[e]46,000
Refinery fuel and losses	do.	4,024	[e]4,000	[e]3,000	[e]3,000	[e]4,000
Total	**do.**	**293,285**	**[e]294,000**	**[e]287,000**	**[e]282,000**	**[e]285,000**
Stone: Granite, broken	thousand cubic meters	7,422	6,743	5,565	7,319	6,914
Sulfur, byproduct of petroleum		5,557	[e]6,000	[e]5,000	[e]5,000	[e]5,000

[e]Estimated [p]Preliminary

[1] Table includes data available through Aug. 18, 1989.

[2] In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

would double to 72,000 tons per year.

Overall, Singapore's trade in 1988 grew 30% to $74.6 billion from $57.2 billion in 1987. Exports rose 31% to $35.3 billion from $26.8 billion, and imports rose 29% to $39.3 billion from $30.4 billion. The country had a global deficit of $4 billion, up from $3.6 billion for 1987. Petroleum products worth $9 billion shipped from the refineries accounted for 18% of the total domestic exports, followed by computer equipment, telecommunications gear, and electronic components. Exports to the United States in 1988 grew 28% over 1987 to $8.4 billion. Trade surplus against the United States was $2.2 billion, 10% higher than in 1987. Sales to regional trade partners and to the EC showed considerably higher growth rates.

Singapore's trade with China was $5.7 billion in 1988, of which 7% covering 170 projects in China, were contracts sealed between Singapore and Chinese traders. There were only 20 Chinese enterprises, joint ventures, business representative offices, and cooperation projects in Singapore, worth $5 million. Compared with that of 1987, exports to China were up 65%, including electrical machines, spare ship parts, specialized equipment, natural rubber, palm oil, and household appliances. On the other hand, imports from China were up 11%, including crude oil, refined oil, textile products, foodstuffs, native and livestock products, light industrial products, arts and crafts, and equipment. Singapore is China's fourth-ranking trade partner in Southeast Asia.

The country's Kimetal tin smelter planned a joint venture with China to build a 200-ton-per-month tin smelter in southwest China. Kimetal, operating on one arc furnace, had been intermittently treating the tin concentrates from various sources at an average rate of 200 tons per month of refined tin output. A spare furnace at Kimetal and most of the other equipment were to be supplied by Singapore to the Chinese smelter. Eventually, another furnace would be added to the smelter in order to double the capacity to 500 tons per month. Singapore has become a major delivery point of zinc and the largest single center of zinc stocks for the London Metal Exchange. The country is also the second largest delivery center for aluminum. Other metals significantly distributed through Singapore include copper, lead, and nickel.

Cement manufacturing and granite quarrying were the major activities in the mineral industry in 1988. Singapore's six major local cement producers were Asia Cement, Indocement, Jurong Cement, Pan Malaysian Cement Works, Singapore Cement, and Ssangyong Cement. Arabian Bulk

TABLE 19

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	—	7	4	NA.
Aluminum:				
Ore and concentrate	7	5	—	All to Malaysia.
Oxides and hydroxides	119,180	31,101	—	China 11,010; Malaysia 5,341; Japan 4,234.
Metal including alloys:				
Scrap	12,434	15,770	120	Japan 13,608; Pakistan 575; Malaysia 477.
Unwrought	6,467	13,107	1	Malaysia 7,140; Japan 2,244; Thailand 1,941.
Semimanufactures	9,193	8,609	89	Australia 3,140; Malaysia 1,692.
Chromium:				
Ore and concentrate	27	20	—	All to Malaysia.
Oxides and hydroxides	29	186	—	Hong Kong 84; North Korea 50; Malaysia 28.
Cobalt: Oxides and hydroxides	8	6	—	Malaysia 3.
Columbium and tantalum:				
Ore and concentrate, tantalum	393	12	NA	Netherlands 11.
Metal including alloys, all forms, tantalum	(2)	(2)	—	All to Malaysia.
Copper:				
Ore and concentrate	1	56	—	Hong Kong 50.
Matte and speiss including cement copper	—	4	—	All to Malaysia.
Metal including alloys:				
Scrap	23,757	29,639	182	India 11,761; Japan 9,441; Republic of Korea 3,330.
Unwrought	7,086	12,499	—	Malaysia 10,840; Hong Kong 1,151.
Semimanufactures	5,199	6,487	10	Malaysia 3,281; Taiwan 632.
Gold:				
Waste and sweepings kilograms	1,280	1,749	170	Japan 1,329; West Germany 248.
Metal including alloys, unwrought and partly wrought troy ounces	132,750	151,591	4,212	Malaysia 75,490; Thailand 13,343.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	19	23	—	Malaysia 20; Thailand 3.
Metal:				
Scrap	90,776	155,625	—	Malaysia 69,105; Thailand 56,295; Japan 24,848.
Pig iron, cast iron, related materials	1,413	996	—	Malaysia 872; Thailand 72.
Ferroalloys:				
Ferromanganese	232	613	—	Malaysia 279; Bangladesh 120; North Korea 113.
Ferrosilicon	206	426	—	Malaysia 355; India 40.
Unspecified	111	80	—	Malaysia 78.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Steel, primary forms	5,124	24,261	—	Taiwan 18,814; Republic of Korea 4,772; Malaysia 529.
Semimanufactures:				
Bars, rods, angles, shapes, sections	141,815	200,987	84,541	Japan 39,096; Malaysia 28,191.
Universals, plates, sheets	85,635	119,206	25	Malaysia 76,580; Hong Kong 6,202.
Hoop and strip	14,275	6,021	3	Malaysia 2,516; Saudi Arabia 1,188.
Rails and accessories	577	2,089	—	Malaysia 2,054.
Wire	3,620	5,032	57	Malaysia 2,453; North Korea 1,000.
Tubes, pipes, fittings	123,089	106,917	35,264	Malaysia 29,302; Brunei 7,306.
Castings and forgings, rough	749	620	113	India 150; Malaysia 68; Papua New Guinea 52.
Lead:				
Ore and concentrate	10	10	—	India 6; Israel 3; Malaysia 1.
Oxides	233	286	—	Malaysia 199; Sri Lanka 81.
Metal including alloys:				
Scrap	5,103	9,690	—	Taiwan 3,209; Republic of Korea 2,420; Philippines 2,148.
Unwrought	5,584	8,608	80	Thailand 3,372; Malaysia 3,044.
Semimanufactures	176	595	NA	Thailand 266; Malaysia 145; Republic of Korea 81.
Magnesium: Metal including alloys, all forms	33	79	—	North Korea 56; Bahrain 10; Malaysia 5.
Manganese:				
Ore and concentrate, battery-grade	23,565	21,772	—	India 4,700; Republic of Korea 4,340; Kenya 2,756.
Oxides	976	2,018	—	Malaysia 1,646; Bangladesh 200.
Mercury 76-pound flasks	174	622	—	Australia 100.
Molybdenum: Metal including alloys, all forms	—	5	—	Mainly to Malaysia.
Nickel:				
Ore and concentrate	—	25	—	Hong Kong 18; Philippines 6.
Matte and speiss	1,307	5	—	Mainly to Malaysia.
Metal including alloys:				
Scrap	280	142	70	India 39; Malaysia 20; United Kingdom 12.
Unwrought	2,399	1,483	—	India 1,073; Taiwan 225.
Semimanufactures	315	1,243	—	Taiwan 699; Thailand 179; Republic of Korea 147.
Platium-group metals: Metals including alloys, unwrought and partly wrought troy ounces	1,800	11,864	8,584	Hong Kong 1,190; West Germany 1,061.
Silver:				
Ore and concentrate[3]	—	21	—	All to Malaysia.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Silver—Continued					
Waste and sweepings[3]	kilograms	1,477	2,428	870	United Kingdom 921; Hong Kong 428.
Metal including alloys, unwrought and partly wrought	troy ounces	121,337	284,630	—	Malaysia 83,656; Thailand 81,277; United Kingdom 42,825.
Tin:					
Ore and concentrate		4,892	10,421	173	Malaysia 6,562; U.S.S.R. 2,268; Republic of Korea 1,151.
Ash and residue containing tin		571	1,378	NA	Netherlands 748; Taiwan 581; Japan 33.
Metal including alloys:					
Scrap		75	77	2	Taiwan 42; Malaysia 22; United Kingdom 10.
Unwrought		29,914	29,820	8,309	Japan 9,417; Netherlands 3,515.
Semimanufactures		243	198	—	Hong Kong 60; India 40; Republic of South Africa 38.
Titanium: Oxides		1,445	1,461	—	Malaysia 569; Taiwan 298; Philippines 161.
Tungsten:					
Ore and concentrate		732	1,166	275	India 301; Hong Kong 195; West Germany 110.
Metal including alloys, all forms		52	86	45	India 28; Taiwan 3.
Uranium and/or thorium: Ore and concentrate		—	2,113	990	Malaysia 623; China 500.
Zinc:					
Ore and concentrate		42	31	—	Thailand 19; Malaysia 11.
Oxides		625	658	—	Japan 435; United Kingdom 56.
Blue powder		91	209	3	Thailand 85; India 60; Malaysia 59.
Metal including alloys					
Scrap		651	538	—	Taiwan 336; Malaysia 96; Belgium-Luxembourg 50.
Unwrought		3,584	5,576	—	Malaysia 2,997; India 1,163; Netherlands 1,075.
Semimanufactures		434	443	332	Malaysia 64; Burma 14.
Other:					
Ores and concentrates		388	573	—	Thailand 441; Malaysia 132.
Ashes and residues		49,310	51,656	25	Malaysia 33,531; Brunei 4,488; Bahrain 3,103.
Base metals including alloys, all forms		144	49	—	North Korea 21; Malaysia 12; Japan 9.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		47	305	—	Thailand 87; Malaysia 86; Sri Lanka 86.
Artificial: Corundun	kilograms	NA	480	—	All to Malaysia.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$1	$22	—	India $10; Switzerland $9.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Abrasives, n.e.s.—Continued				
Grinding and polishing wheels and stones	275	394	(4)	Malaysia 250; Thailand 63.
Asbestos, crude	4,276	848	—	Malaysia 828; India 14.
Barite and witherite	12,939	12,870	—	Malaysia 8,034; Papua New Guinea 1,822; Brunei 1,065.
Boron materials:				
Crude natural borates	10	105	—	All to Malaysia.
Oxides and acids	183	269	—	Malaysia 211; North Korea 20.
Cement	66,927	97,635	—	Malaysia 38,911; Sri Lanka 14,949; Brunei 10,265.
Chalk	2,781	1,559	—	Malaysia 781; Brunei 527; Philippines 162.
Clays, crude	12,065	16,438	18	Malaysia 7,351; Thailand 2,039; Japan 1,495.
Diamond:				
Gem, not set or strung value, thousands	$8,539	$19,277	$641	Belgium-Luxembourg $4,981; Malaysia $3,507; Hong Kong $3,061.
Industrial stones do.	$264	$220	$20	Hong Kong $86; Malaysia $86.
Diatomite and other infusorial earth	115	223	—	Malaysia 93; Thailand 91; Sri Lanka 20.
Feldspar	3,585	1,597	—	Malaysia 1,593.
Fertilizer materials:				
Crude, n.e.s.	40,654	36,129	—	Malaysia 36,090; Brunei 31.
Manufactured:				
Ammonia	307	364	—	Malaysia 126; Thailand 110; Maldives 37.
Nitrogenous	17,877	26,663	—	Malaysia 6,522; Papua New Guinea 4,018.
Phosphatic	16,356	11,602	—	Burma 7,400; Kenya 3,000; Papua New Guinea 668.
Potassic	141,368	139,992	—	Sri Lanka 69,270; Malaysia 31,630; Thailand 13,517.
Unspecified and mixed	54,128	59,820	—	Malaysia 57,910; Brunei 1,121.
Graphite, natural	77	69	—	Malaysia 46; Italy 17.
Gypsum and plaster	2,739	5,040	—	Malaysia 4,620; Brunei 283; Thailand 81.
Lime	2,919	2,814	—	Brunei 1,671; Malaysia 929.
Magnesium compounds:				
Magnesite, crude including calcined	172	480	—	Malaysia 318; Taiwan 90.
Mica:				
Crude including splittings and waste	51	298	—	Malaysia 107; Hong Kong 56.
Worked including agglomerated splittings	11	4	—	Japan 1.
Nitrates, crude	555	33	—	Brunei 32; Malaysia 1.
Phosphates, crude	2,605	898	—	Malaysia 592; Brunei 120; Hong Kong 76.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Pigments, mineral: Iron oxides and hydroxides, processed	639	706	—	Malaysia 544; Taiwan 62; Philippines 44.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$3,559	$6,649	$387	Thailand $3,451; Switzerland $1,174; Hong Kong $1,108.
Synthetic do.	$412	$613	$9	Malaysia $198; Thailand $191; Switzerland $104.
Pyrite, unroasted	—	1	NA	NA.
Salt and brine	9,216	9,663	—	Malaysia 7,733; Brunei 1,570.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	1,387	5,946	—	Malaysia 5,401; Australia 40; Seychelles 40.
Sulfate, manufactured[5]	11,038	8,455	—	Malaysia 8,268.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	233	445	1	Taiwan 252; Malaysia 113; Hong Kong 40.
Worked	4,715	4,503	191	Malaysia 2,279; Hong Kong 503; Brunei 388.
Dolomite, chiefly refractory-grade	1,268	685	—	Papua New Guinea 681.
Gravel and crushed rock	390	3,614	—	Malaysia 3,321; Republic of Korea 31.
Limestone other than dimension	86	222	—	Malaysia 217; Brunei 6.
Sand other than metal-bearing	698	10,794	—	Japan 6,000; Australia 2,551; Malaysia 2,237.
Sulfur:				
Elemental:				
Crude including native and byproduct	15,885	24,815	—	Thailand 11,962; Malaysia 7,993; Philippines 4,701.
Colloidal, precipitated, sublimed	10,600	22,207	—	Malaysia 10,747; Philippines 5,026; Thailand 4,927.
Sulfuric acid	1,743	1,753	—	Malaysia 888; Sri Lanka 655; Brunei 129.
Talc, steatite, soapstone, pyrophyllite	512	890	—	Malaysia 829; Republic of South Africa 20.
Other:				
Crude	5,379	3,806	—	Philippines 2,105; Thailand 520; Sri Lanka 500.
Slag and dross, not metal-bearing	7,480	8,393	—	Japan 5,606; Malaysia 2,422; Brunei 253.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	19,387	10,854	—	Burma 3,480; China 3,001; Kenya 1,200.
Carbon:				
Carbon black	5,632	5,400	52	Malaysia 610; Pakistan 421; Thailand 396.
Gas carbon	7	2	NA	NA.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal, all grades including briquets		r1,601	248	—	Malaysia 70; Philippines 67; Australia 44.
Coke and semicoke		17,462	14,500	—	Malaysia 12,323; Sri Lanka 873; Thailand 566.
Peat including briquets and litter		6	9	—	Malaysia 6; Brunei 3.
Petroleum:					
Crude	thousand 42-gallon barrels	649	714	—	Malaysia 421; Japan 293.
Refinery products:					
Liquefied petroleum gas	do.	2,566	2,712	—	Malaysia 1,588; Hong Kong 948.
Gasoline	do.	41,723	38,338	114	Japan 14,051; Malaysia 9,571.
Mineral jelly and wax	do.	213	(4)	—	NA.
Kerosene and jet fuel	do.	41,228	45,784	3,496	Japan 20,628; Hong Kong 8,179.
Distillate fuel oil	do.	59,673	58,114	1,273	Thailand 16,740; Malaysia 8,236.
Lubricants	do.	3,843	4,257	10	Malaysia 905; India 812; Thailand 748.
Residual fuel oil	do.	63,214	56,741	8,911	Japan 16,091; Malaysia 10,994.
Bitumen and other residues	do.	2,449	2,069	—	Malaysia 628; Japan 312, Republic of South Africa 227.
Bituminous mixtures	do.	130	7	—	Tanzania 4; Yemen, Sanaa 2.
Petroleum coke	do.	2	(4)	—	All to Malaysia.

r Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes and Peter J. Roetzel.
[2] Unreported quantities valued at $6,000 in 1986 and $1,000 in 1987.
[3] May include other precious metals.
[4] Less than 1/2 unit.
[5] Includes hydrogen sulfate and pyrosulfate.

Trade, another major domestic supplier, imported cement from such countries as Japan, Malaysia, and Taiwan. Cement manufacturers attributed the price increases to a shortage of raw materials, including clinker that had to be imported mainly from Indonesia, Japan, and Malaysia. In 1988, the building industry used 1.7 million tons of cement.

Due to higher oil and petrochemical demand by countries including Indonesia, Japan, and Thailand, Singapore's oil refining industry operated at near full capacity throughout 1988. Shell Singapore, BP Singapore, and Singapore Refining Co. (SRC) were processing up to 100,000 bbl/d each to meet the demand and China's Sinochem Corp. processed 70,000 bbl/d of its crude oil in Singapore. Shell Singapore's $480 million, long-residue-catalytic-cracker complex at Pulau Ular was being constructed. This plant, which will convert fuel oil into high value-added products like diesel, kerosene, and gasoline, was scheduled for completion by the end of 1989. SRC planned to upgrade its Pulau Merlimau refinery with an investment of $100 million on four major projects. Singapore Petroleum Co. planned to invest $30 million in the expansion of its oil storage terminal at Jurong from 20,000 to 120,000 tons. Shell Eastern Petroleum Pte. Ltd. was to add an isopropyl alcohol manufacturing plant to its refining facilities at Pulau Ular at a cost of $41 million. Esso Singapore Pte. Ltd. planned to spend $65 million for upgrading its 176,000-bbl/d refinery at Pulau Ayer.

TABLE 20

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	—	10	1	Japan 8.
Aluminum:				
Ore and concentrate	20	10	—	Belgium-Luxembourg 7; Australia 3.
Oxides and hydroxides	103,137	75,224	630	Australia 72,417; Japan 1,822.
Metal including alloys:				
Scrap	845	1,525	15	Malaysia 551; Saudi Arabia 315; New Zealand 246.
Unwrought	15,679	40,628	5,052	Australia 18,591; United Kingdom 3,728.
Semimanufactures	29,262	40,498	1,051	Japan 8,566; Malaysia 8,013; Taiwan 4,689.
Beryllium: Metal including alloys, all forms	12	9	(2)	Japan 8.
Chromium:				
Ore and concentrate	8	23	—	Japan 13; Netherlands 10.
Oxides and hydroxides	151	364	45	United Kingdom 158; Italy 88.
Cobalt: Oxides and hydroxides	29	19	—	Canada 7; China 7; Finland 5.
Columbium and tantalum:				
Ore and concentrate	(2)	10	—	All from Thailand.
Metal including alloys, all forms, tantalum	46	5	3	Thailand 1.
Copper:				
Ore and concentrate value, thousands	$20	$2	NA	West Germany $1.
Matte and speiss including cement copper	16	20	—	Brazil 17; Malaysia 3.
Metal including alloys:				
Scrap	7,401	7,873	1,264	Malaysia 4,130; Japan 549.
Unwrought	5,660	12,775	160	Chile 6,000; Japan 2,968; Zambia 1,501.
Semimanufactures	34,169	45,532	549	Japan 22,850; Malaysia 8,300; Taiwan 4,234.
Gold:				
Waste and sweepings value, thousands	$3,839	$5,777	$178	Hong Kong $2,472; Malaysia $1,591; West Germany $889.
Metal including alloys, unwrought and partly wrought troy ounces	125,002	155,931	21,284	Japan 128,956.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	10,167	1,140	—	All from Malaysia.
Metal:				
Scrap	209,091	126,698	225	Netherlands 34,994; Malaysia 29,214; U.S.S.R. 22,176.
Pig iron, cast iron, related materials	60,015	74,140	57	U.S.S.R. 50,073; Australia 22,120.
Ferroalloys:				
Ferromanganese	3,183	1,960	—	Mozambique 1,140; China 500; West Germany 101.
Ferrosilicon	2,718	3,958	NA	Mozambique 2,600; China 714; Norway 255.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Ferroalloys—Continued				
Unspecified	4,898	5,627	19	Mozambique 4,760; China 682.
Steel, primary forms	245,461	170,721	38	Brazil 47,167; Australia 41,633; Malaysia 34,891.
Semimanufactures:				
Bars, rods, angles, shapes, sections	337,457	439,128	656	United Kingdom 119,778; Japan 107,291; Malaysia 105,848.
Universals, plates, sheets	626,239	753,423	942	Japan 439,541; Republic of Korea 70,296; Brazil 52,004.
Hoop and strip	21,540	23,123	598	Japan 9,248; Republic of Korea 5,963; Australia 2,497.
Rails and accessories	14,792	28,261	7	United Kingdom 17,168; Republic of Korea 9,226.
Wire	27,696	31,616	109	China 10,458; Japan 8,143; Republic of Korea 3,820.
Tubes, pipes, fittings	254,827	234,197	3,180	Japan 108,058; Malaysia 36,249; West Germany 17,991.
Castings and forgings, rough	6,803	6,748	787	Japan 2,693; Australia 1,341.
Lead:				
Ore and concentrate	1	10	—	All from Morocco
Oxides	381	322	9	Australia 120; United Kingdom 85; West Germany 38.
Metal including alloys:				
Scrap	133	1,425	33	Malaysia 659; Japan 535; Brunei 133.
Unwrought	9,673	16,206	67	Australia 4,882; Japan 3,837.
Semimanufactures	831	544	15	Australia 147; Japan 144; Ireland 77.
Magnesium: Metal including alloys:				
Scrap	2	—		
Unwrought	21	40	7	Japan 11; Malaysia 11; Norway 8.
Semimanufactures	—	141	21	Japan 116.
Manganese				
Ore and concentrate	28,846	45,512	—	Gabon 36,000; Brazil 5,000; Mexico 3,921.
Oxides	2,327	3,433	2	Japan 2,538; Malaysia 488; Australia 195.
Mercury 76-pound flasks	928	1,315	294	China 979; United Kingdom 34.
Molybdenum: Metal including alloys, all forms	1	4	1	United Kingdom 3.
Nickel:				
Ore and concentrate	—	5	—	All from Finland.
Metal including alloys:				
Scrap	182	284	—	Malaysia 114; Thailand 63; Japan 51.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Nickel—Continued				
Metal including alloys—Continued				
Unwrought	3,726	1,493	(2)	New Caledonia 879; Canada 464; United Kingdom 55.
Semimanufactures	1,410	4,189	128	Canada 2,061; Japan 1,314.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	17,394	43,628	17,008	Japan 9,742; West Germany 8,456.
Selenium, elemental	—	[3]189	6	China 128; Japan 23; Australia 14.
Silver:				
Ore and concentrate value, thousands	$1	—		
Waste and sweepings[4] do.	$55	$1,030	$5	West Germany $801; Taiwan $154.
Metal including alloys, unwrought and partly wrought thousand troy ounces	3,145	4,509	198	West Germany 2,029; Australia 924; Japan 410.
Tin:				
Ore and concentrate	5,501	12,064	—	China 10,788; Malaysia 681; Bolivia 407.
Ash and residue containing tin	9,585	9,749	—	Malaysia 9,748.
Metal including alloys:				
Scrap	281	536	—	Malaysia 521; Philippines 8; Thailand 7.
Unwrought	12,742	11,021	15	Malaysia 5,745; Thailand 4,562.
Semimanufactures	288	93	(2)	Japan 44; Malaysia 19; Taiwan 10.
Titanium: Oxides	8,725	8,508	1,511	Japan 2,605; Australia 1,224.
Tungsten:				
Ore and concentrate	1,235	1,175	—	Burma 618; Japan 254; China 248.
Metal including alloys, all forms	101	105	2	China 83; Austria 5.
Uranium and/or thorium:				
Oxides and other compounds value, thousands	$130	$159	$22	France $103; Austria $13.
Metal including alloys, all forms, kilograms	2	303	—	All from United Kingdom.
Zinc:				
Ore and concentrate	40	40	—	Thailand 20; Australia 14.
Oxides	957	763	176	China 180; Thailand 95.
Blue powder	221	1,510	373	Norway 852; United Kingdom 179.
Metal including alloys:				
Scrap	221	574	—	Malaysia 464; Australia 39.
Unwrought	11,763	26,496	3	North Korea 12,148; Australia 5,057; Canada 4,821.
Semimanufactures	414	357	24	Australia 137; Belgium-Luxembourg 43.
Other:				
Ores and concentrates	605	1,861	—	Malaysia 1,057; Bolivia 413; Burma 220.
Ashes and residues	177,613	246,952	2	Japan 198,119; Philippines 26,248; Australia 21,871.
Base metals including alloys, all forms	31	212	18	United Kingdom 39; Mozambique 37; Japan 32.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	516	400	113	China 174; Japan 28.
Artificial: Corundum	30	12	—	Japan 11.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$406	$172	$8	U.S.S.R. $68; Ireland $49; China $16.
Grinding and polishing wheels and stones	2,350	2,333	60	China 803; Japan 572; Taiwan 328.
Asbestos, crude	3,987	2,194	51	Canada 730; Cyprus 278; Italy 252.
Barite and witherite	14,382	12,766	211	Malaysia 7,808; Thailand 1,830; China 1,470.
Boron materials:				
Crude natural borates	109	—		
Oxides and acids	498	975	397	Italy 486; China 60.
Cement thousand tons	2,103	1,933	(2)	Malaysia 560; Japan 546; Taiwan 498.
Chalk	5,735	8,313	—	Malaysia 2,837; Thailand 1,437; Australia 1,399.
Clays, crude:				
Bentonite	36,360	9,431	8,643	United Kingdom 327; China 170.
Fuller's earth	5,301	1,467	420	Japan 427; Malaysia 197.
Unspecified	18,963	12,293	901	Malaysia 7,018; United Kingdom 1,490; Australia 1,171.
Cryolite and chiolite	5	2	—	All from Japan.
Diamond:				
Gem, not set or strung value, thousands	$39,843	$50,567	$5,371	India $14,917; Israel $10,983; Belgium-Luxembourg $10,815.
Industrial stones do.	$644	$376	$71	Ireland $208; India $81.
Diatomite and other infusorial earth	963	1,139	1,017	Philippines 50; France 49.
Feldspar, fluorspar, related materials	4,413	1,613	—	China 1,057; Thailand 298; India 190.
Fertilizer materials:				
Crude, n.e.s.	778	629	—	Australia 247; China 141.
Manufactured:				
Ammonia	621	809	1	Malaysia 551; Belgium-Luxembourg 112; West Germany 87.
Nitrogenous	5,256	21,527	55	Malaysia 10,398; Canada 7,046; West Germany 2,321.
Phosphatic	22,456	16,493	15,389	China 942; Malaysia 163.
Potassic	155,536	127,861	2,974	Canada 90,594; Jordan 17,400; West Germany 10,168.
Unspecified and mixed	42,091	62,231	258	West Germany 57,454; Belgium-Luxembourg 2,233.
Graphite, natural	407	314	1	Japan 136; China 51; Republic of Korea 51.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	56,130	77,647	192	Thailand 52,926; Australia 18,803.
Iodine including bromine and fluorine value, thousands	—	$116	$74	Japan $19; West Germany $8.
Lime	5,010	3,339	—	Malaysia 2,604; China 399; United Kingdom 301.
Magnesium compounds: Magnesite, crude including calcined	472	1,781	34	China 940; Japan 657.
Mica:				
Crude including splittings and waste	496	382	15	India 151; China 150.
Worked including agglomerated splittings	17	148	1	Japan 108; Malaysia 17.
Nitrates, crude	—	1	NA	NA.
Phosphates, crude	4,920	3,445	50	Malaysia 1,968; India 1,000.
Pigments, mineral: Iron oxides and hydroxides, processed	3,058	4,035	165	West Germany 1,413; Japan 1,108; China 720.
Potassium salts, crude	30	500	–	All from West Germany.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$2,834	$6,845	$815	Thailand $1,442; Switzerland $1,155; Sri Lanka $972.
Synthetic do.	$737	$1,674	$260	U.S.S.R. $464; Ireland $367.
Pyrite, unroasted	43	—		
Salt and brine	36,700	47,136	89	Australia 22,106; Thailand 10,895; China 5,861.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	347	2,366	3	Poland 800; Sri Lanka 488; Malaysia 373.
Sulfate, manufactured[5]	20,748	8,800	2,053	China 4,440; Taiwan 1,015.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	1,228	1,873	9	China 815; Italy 643.
Worked	34,529	39,722	11	Italy 21,918; China 6,625.
Dolomite, chiefly refractory-grade	127	519	—	China 308; Norway 152; France 40.
Gravel and crushed rock	697,463	758,267	44	Malaysia 756,815.
Limestone other than dimension	72,178	69,257	—	Malaysia 69,210.
Quartz and quartzite	172	187	(2)	China 160; West Germany 22.
Sand other than metal-bearing thousand tons	1,205	1,298	3	Malaysia 1,274; Thailand 18.
Sulfur:				
Elemental:				
Crude including native and byproduct	142	168	3	Poland 90; China 37; West Germany 21.
Colloidal, precipitated, sublimed	510	216	3	Poland 126; Republic of Korea 34.
Sulfuric acid	302	387	38	Malaysia 123; West Germany 111.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		6,205	5,163	141	China 2,721; Republic of Korea 589; Norway 478.
Other:					
Crude		32,489	56,563	17	West Germany 55,024; Mozambique 522; Malaysia 509.
Slag and dross, not metal-bearing		12,818	20,987	1	Taiwan 19,737
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2,186	2,569	282	Taiwan 942; Japan 713; Republic of Korea 566.
Carbon:					
Carbon black		4,621	4,808	348	Republic of Korea 1,157; Malaysia 884; West Germany 568.
Gas carbon		—	7	NA	NA.
Coal, all grades including briquets		1,825	1,157	453	United Kingdom 321; India 172.
Coke and semicoke		27,434	32,392	—	Japan 23,287; Australia 8,617.
Peat including briquets and litter		182	208	—	Netherlands 80; New Zealand 36; United Kingdom 32.
Petroleum:					
Crude	thousand 42-gallon barrels	236,830	231,108	—	Saudi Arabia 38,453; Malaysia 38,120; China 34,553.
Refinery products:					
Liquefied petroleum gas	do.	17	75	(2)	Malaysia 31; Philippines 26.
Gasoline	do.	13,209	16,318	477	Saudi Arabia 4,217; Malaysia 3,649; Bahrain 1,863.
Mineral jelly and wax	do.	170	144	2	China 121; Burma 9.
Kerosene and jet fuel	do.	3,975	4,678	255	Malaysia 1,411; United Arab Emirates 925; Saudi Arabia 800.
Distillate fuel oil	do.	9,066	10,380	269	Saudi Arabia 4,039; Malaysia 2,072; China 2,042.
Lubricants	do.	927	1,085	90	Japan 332; China 186; Netherlands Antilles 73.
Residual fuel oil	do.	54,797	74,512	4,044	Saudi Arabia 28,002; Kuwait 14,802; Bahrain 11,983.
Bitumen and other residues	do.	1	6	—	Mainly from Burma.
Bituminous mixtures	do.	37	20	1	United Kingdom 10; Spain 3.
Petroleum coke	do.	28	25	24	China (2).

NA Not available.
[1] Table prepared by Audrey D. Wilkes and Peter Roetzel.
[2] Less than 1/2 unit.
[3] May include tellurium and phosphorus.
[4] May include other precious metals.
[5] Includes hydrogen sulfate and pyrosulfate.

THAILAND[70]

Production of all mineral commodities in Thailand increased substantially, rising from $417 million[71] in 1987 to a little over $500 million in 1988. This increase reflected an expanding mineral industry in the midst of an even greater expansion of the overall economy.[72] The value of all minerals produced amounted to slightly under 1% of the Thai gross national product (GNP).

Long one of the world's principal sources of tin, which was still its leading export mineral commodity in 1988, Thailand and other tin producers have been nursing their industry back to some degree of profitability since the 1985 collapse of the world tin market. It seemed clear that in Thailand as well as other countries the marginal operators probably would not come back. Both lignite and zinc exceeded tin in value of 1988 production. Lignite was consumed entirely in the domestic generation of electricity, and zinc was used increasingly for domestic galvanizing, which led to a decrease in zinc exports. Gypsum continued to increase significantly in both production and export to a growing Asian market. Other Thai minerals of potential importance to the world market were a large undeveloped potash resource and a chromite resource in the very early stages of development.

After firmer prices for petroleum on world markets, drilling activity increased both onshore and offshore. Amidst adjustments in ownership, size, and taxation of petroleum concessions, new discoveries of crude in central Thailand, as well as in the Gulf of Thailand, lent encouragement to exploration for hydrocarbons within the notable structural complexity of the country's geology.

Thai mineral-commodity export earnings were up almost 20% at $205 million. However, the country's booming economic growth, up 11% (in baht terms) over that of the previous year and the best in two decades, absorbed imports on a rapidly increasing scale. The resulting negative balance of trade was estimated to have more than doubled at about $3,363 million, tentatively estimated to be 3.2% to 5.9% of the GNP. Per capita GNP surpassed the $1000 mark for the first time at an estimated $1,045. With these changes came increasing energy consumption and heavier demand on power generation. This led to concerted expansion of the electric power grid of Thailand, the consumption of more natural gas and more lignite for fuel, and an ever-increasing stimulus to the search for mineral fuels. Thailand clearly was a leading participant in the industrialization of Asia, in obvious contrast to surrounding centrally planned economies.

Government Policies and Programs

The Provincial Electric Authority of Thailand (PEA) planned to be able to offer electricity to 95% of the nation's villages, which would not only require power generation on a somewhat larger scale but also require dependable sources of fuel at prices that would not impose an unrealistic rate structure on the rural areas. PEA replaced outmoded equipment as it expanded its grid, but did not attract capital investment on the scale needed. This was largely due to a need for better regulatory authority in relation to large industrial users as well as for purposes of health and safety. Better definition of statutory authority was needed where PEA's interest conflicted with other Government agencies such as the highway department. It was clear that domestic lignite was the most economical fuel, but Thai Government officials were eyeing clean-coal technology and the possibility of fluidized-bed combustion adapted to blends of lignite and coal.

Airborne magnetic and radiometric surveys were completed for the entire country, and the airborne electromagnetic survey neared completion. Kenting Earth Sciences International Ltd. of Canada with funding by the Asian Development Bank and the Canadian International Development Agency (CIDA), performed the airborne surveys and recorded many anomalies thought to indicate mineralization. Followup studies on the ground were planned for pinpointing mineral prospects.

The National Resources Policy Committee was reactivated in 1988 in order to encourage private investment in exploration and mining development as intended in the Sixth National Economic and Social Development Plan. For purposes of encouraging foreign investment in minerals by circumventing bureaucratic obstacles, the work of the committee was concerned with (1) the elimination of unnecessary steps in the application for mining concessions, (2) establishment of one-stop clerical service units, (3) the restructuring of mineral royalty rates, (4) amendment of the Mineral Act 04 B.E. 2510 (1967), and (5) designation of Mineral Deposit Zones for mineral development. Although much remained to be accomplished, particularly in the effort to attract interest and investment in Thailand's gold and potash resources, sympathetic treatment was accorded industries such as petroleum, lead, and zinc. In particular, the Thai tin industry was specially controlled following the 1985 collapse of the world tin market, but more recently subsidized by low royalties in an effort to keep it competitive as the world tin markets slowly improved.

Production

The total value of mineral production in Thailand for 1988 was over $500 million, an increase of 20% from $417 million in 1987. Lignite exceeded all other minerals in value of production, reaching a value of about $150 million for 7 million tons mined. Tin output continued its slump in the light of Government constraints on the issuance of new tin-mining licenses. Although royalties were eased in an effort to get production high enough to enable Thailand to meet its 1988 ATPC quota of 19,000 tons, the quota was not reached. Production of tin concentrates

reached about 20,000 tons worth $101 million, while exports fell slightly to 13,400 tons, worth $86 million. Zinc surpassed tin for the first time with an output of almost 400,000 tons of ore worth $108 million, becoming second only to lignite. Added capacity at the Padaeng refinery was a contributing factor. Gypsum production reached 4.5 million tons worth $44 million. Limestone production, 14 million tons worth $47 million, went almost completely to the domestic cement industry to satisfy the expanding requirements for construction in Thailand.

Natural gas production exceeded 200 billion cubic feet for the first time at 212 billion cubic feet, most of which was earmarked for the generation of electric power and industrial fuel. Petroleum crude reached 7,437 million barrels in 1988, not quite as high as 1985 and 1986 but substantially above the 1987 output of slightly more than 6,100 million barrels.

The use of mechanical equipment has enabled an impressive revival in sapphire mining[73] in the vicinity of Bo Ploi and Kanchanaburi starting in August of 1988. Operations were said to run 20 hours per day, 365 days per year, recovering about 500 carats per plant per day. Although the term "plant" was neither defined nor described, nor was the number of such plants, the volume of sapphire in Bangkok markets had visibly increased.

Two significant nonproductive categories were gold and potash, minerals known to occur in Thailand but for which the Thai Government had, as of the end of 1988, still not worked out investment arrangements.

Trade

Trade increased at a greater rate than in 1987 and reflected the vigor of the Thai economy. Although the value of all exports for 1988 was a little over $16 billion, up 35.9%, imports were up 46.5% at slightly more than $19.8 billion. This increased the negative balance of trade, inexactly called the trade "deficit." The value of Thai mineral exports was approximately $205 million,[74] or a little over 1% of total exports, and up 19% over 1987.

Although lignite led all other Thai minerals in value produced, export of lignite was prohibited in favor of domestic requirements for electric power generation. Tin again led in mineral export revenues but, even so, it did not fulfill Thailand's agreed ATPC quota. Other major mineral exports for 1988 were gypsum, $38 million, up 189%; tin slag, over $18 million, up 236%; and lead, over $13 million, up 37%. Zinc exports, worth $13 million, were down one-third in tonnage and 16% in value, mostly as a consequence of the continued increase in domestic use for galvanizing. Barite exports, valued at less than $5 million, were up sharply from the previous year but, nonetheless, were still trying to recover from the lack of demand for drilling muds in the petroleum industry. Fluorite exports, at slightly under $5 million, were down about 21% as the result of competition from China.

Other mineral exports, each accounting for $4 million or less in 1988, were antimony and tungsten, as well as the industrial minerals dolomite, granite, and marble. The latter three, in some cases, reflected production by operators formerly producing barite. A newly burgeoning commodity, feldspar, accounted for nearly $5 million revenue on 185,000 tons, up 118% in tonnage from that of 1987.

Representatives of the Thai Mining Industry Council negotiated a price agreement on tungsten in 1988 and planned to discuss a price pact on antimony, barite, and fluorite before the end of the fiscal year.

Chromite, intended for export, was mined in Thailand, but it was withdrawn after it was recognized that the material offered did not meet specifications.

Commodity Review

***Metals.*—Antimony.**—Thai antimony metal production continued its climb to another record high in 1988 by nearly doubling the output of 1987, despite a very modest increase in actual mine production. The antimony content of mined ore increased from 409 tons in 1987 to 445 tons in 1988 while metal production increased, respectively, from 959 to 1,769 tons. Exports of antimony metal likewise increased from 720 to approximately 2,500 tons; therefore, the question arose as to the source of the antimony. Production and export data from past years did not support the idea of large stockpiles providing carryover from year to year. One possibility was the smuggling of antimony concentrates and antimony metal from Burma into Thailand for processing and export.

Chromite.—Chromite appeared for the first time in the mineral production data for Thailand, more for its potential significance than its production volume. After a small start in 1985 with the production of 30 tons of ore from a small mine near Nan, a second mine was opened in 1986 near Utteradit in northern Thailand. The 1988 mine production of 776 tons of chromite ore, of unspecified grade, suggested a continuing effort to locate and exploit this strategic metal. The geology was believed favorable in several places in Thailand for typical mineralization associated with ultrabasic rocks including chromium, nickel, and platinum. The Thai Department of Mineral Resources has added chromite to its official mineral statistics publications.

Columbium and Tantalum.—Construction of the proposed tantalum-processing plant at Map Ta Put, which was intended to replace the one consumed by fire at Phuket several years ago, has not gone forward in spite of the Government's acknowledged commitment to see it through. The availability of tantalum-extraction technology originally offered by Hermann C. Starck, now owned by Bayer AG, of the Federal Republic of Germany, is very doubtful. The Thai Government posi-

TABLE 21

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Antimony:						
Ore and concentrate:						
Gross weight		4,636	2,917	2,397	962	1,048
Sb content[e]		1,970	1,240	1,019	409	445
Metal, smelter		—	135	386	959	1,769
Columbium and tantalum ores and concentrates, gross weight:[2]						
Columbite and tantalite:						
Gross weight	kilograms	477,000	432,000	121,000	183,000	124,000
Cb content	do.	81,000	73,400	20,600	31,110	21,080
Ta content	do.	128,800	116,640	32,670	49,410	33,480
Struverite:						
Gross weight	do.	30,000	309,000	241,000	423,000	788,000
Cb content	do.	2,400	24,800	19,400	34,003	63,343
Ta content		2,300	24,000	18,800	32,912	61,310
Iron and steel:						
Iron ore:						
Gross weight		60,670	93,800	37,330	97,026	99,257
Fe content		33,369	51,590	20,532	53,364	54,591
Metal: Steel:						
Crude		380,971	447,035	463,393	534,172	552,000
Semimanufactures (selected):						
Bars		281,934	319,330	303,652	319,835	356,000
Galvanized iron sheets		151,537	131,520	144,444	165,445	189,996
Tinned plates		91,991	68,175	104,433	119,342	147,337
Lead:						
Mine output, Pb content of 42.5% Pb concentrate		16,662	19,654	26,301	23,503	29,474
Metal: Ingot, secondary		6,198	7,536	9,122	11,366	15,614
Manganese ore:						
Chemical-grade, over 75% MnO_2		8	27	—	50	—
Battery- and chemical-grade, 75% MnO_2		6,110	3,930	4,001	5,062	3,247
Metallurgical-grade, 46% to 50% MnO_2		2,577	455	887	4,086	4,417
Total, gross weight		**8,695**	**4,412**	**4,888**	**9,148**	**7,664**
Total, Mn content		**4,174**	**2,118**	**2,346**	**4,391**	**3,679**
Rare-earth metals:						
Monazite concentrate, gross weight		298	663	1,609	458	590
Xenotime		28	158	28	30	101
Tin:						
Mine output, Sn content		21,607	16,593	16,800	14,852	14,225
Metal, smelter, primary		19,729	17,996	19,672	15,438	14,675
Titanium: Ilmenite concentrate, gross weight		148	1,078	13,489	26,278	16,455

See footnotes at end of table.

TABLE 21—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
METALS—Continued					
Titanium—Continued					
Leucoxine concentrate, gross weight	388	488	797	800	1,799
Rutile concentrate, gross weight	—	110	48	92	128
Tungsten concentrate:					
Mine output, gross weight	1,439	1,137	922	1,269	1,173
Mine output, W content	741	586	r475	705	651
Zinc:					
Mine output, gross weight	147,993	276,909	373,833	341,145	420,102
Mine output, Zn content	41,438	77,535	97,197	88,698	78,000
Metal, smelter, primary	—	62,108	58,552	66,868	68,600
Zirconium ore and concentrate, gross weight	290	1,292	1,705	1,532	5,098
INDUSTRIAL MINERALS					
Barite	174,918	230,970	142,232	33,370	40,587
Cement, hydraulic thousand tons	8,271	7,916	7,940	9,850	11,514
Clays:					
Ball clay	2,520	7,988	11,203	57,719	86,890
Kaolin, beneficiated	58,616	106,704	116,037	184,179	222,964
Kaolin, nonbeneficiated	—	—	16,118	22,389	46,724
Diatomite	471	410	204	177	470
Feldspar	74,404	104,586	115,163	168,881	293,678
Fluorspar:					
Crude mine output:					
High-grade	230,228	263,059	156,409	102,398	76,321
Low-grade	64,995	91,500	40,715	2,154	20
Total	**295,223**	**354,559**	**197,124**	**104,552**	**76,341**
Salable product:					
Acid-grade (beneficiated low-grade)	57,151	35,840	11,500	—	—
Metallurgical-grade	230,228	263,059	156,409	102,398	76,321
Total	**287,379**	**298,899**	**167,909**	**102,398**	**76,321**
Gypsum	1,110,660	1,273,459	1,665,557	3,030,919	4,549,011
Phosphate rock, crude	3,075	4,072	4,940	4,502	8,348
Salt:					
Rock	9,850	12,786	2,000	3,268	5,670
Other[e]	165,000	165,000	165,000	165,000	165,000
Sand, silica	166,787	152,133	153,565	153,516	242,385
Stone:					
Calcite	1,272	1,040	230	2,170	171
Dolomite	10,364	16,160	13,771	50,767	140,455
Limestone for cement manufacture only thousand tons	9,223	9,845	9,605	11,391	14,101
Marble	37,927	21,479	14,718	22,786	42,553

See footnotes at end of table

TABLE 21—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued					
Stone—Continued					
Marl for cement manufacture only thousand tons	—	—	—	296	136
Quartz, not further described	20,687	27,305	18,068	27,459	28,449
Shale for cement manufacture only thousand tons	1,564	1,448	1,013	1,403	2,283
Talc and related materials:					
Pyrophyllite	26,851	42,002	36,165	37,749	37,285
Talc	1,628	1,476	2,886	4,101	4,843
MINERAL FUELS AND RELATED MATERIALS					
Coal: Lignite thousand tons	2,337	5,149	5,545	6,929	7,274
Natural gas (gross production) million standard cubic feet	85,506	132,275	127,765	178,658	211,641
Petroleum:					
Crude thousand 42-gallon barrels	5,387	7,918	7,738	6,108	7,437
Natural gas condensate do.	3,008	5,202	5,207	5,541	5,433
Refinery products:					
Gasoline do.	12,620	12,836	13,837	[e]13,900	15,781
Jet fuel do.	6,432	6,474	7,227	[e]7,200	8,183
Kerosene do.	1,539	1,036	931	[e]1,000	811
Distillate fuel oil do.	17,409	21,127	23,115	[e]23,200	22,021
Residual fuel oil do.	15,494	13,353	13,768	[e]13,800	15,907
Liquefied petroleum gas do.	1,541	1,555	1,566	[e]1,600	1,931
Refinery fuel and losses and unspecified do.	2,671	2,467	1,264	[e]2,000	2,447
Total do.	**57,706**	**58,848**	**61,708**	**[e]62,700**	**67,081**

[e] Estimated. [p] Preliminary. [r] Revised.

[1] Includes data available through Aug. 4, 1989.

[2] Excludes columbium- and tantalum-bearing tin slags, which make Thailand the world's largest source of newly mined tantalum.

tion was that new technology and new financing would be required. The amount of tin slag exported for processing elsewhere soared to 2,110 tons, an increase of 236% over that of 1987. Such an increase indicated the potential availability of this material for domestic processing when, or if, the Map Ta Put plant can be constructed and put on-stream. For the first time, struverite clearly and substantially exceeded higher grade ores and their concentrates as a source of tantalum (by a factor of 2) and columbium (by a factor of 3).

Gold.—The Thai Government continued to struggle with its own sponsorship and regulation of a gold-mining industry. With signficant publicity, the Government announced on several occasions the reception of bids for gold-prospecting concessions in several parts of the country. Shortly thereafter, the offered concessions were revoked by the industry minister, elections were held, and his successor entertained new submittals for concessions in five areas: Loei, Udon Thani, and Nong Khai in northeast Thailand, and in Chonburi and Prachinburi east and south of Bangkok. By November 1988, in a second effort, two overseas investors and three joint Thai-foreign bids were submitted. As of the end of 1988, no new concessions had been granted. In the meantime, the reported production of gold for that year amounted to 564 grams, or a little more than 18 troy ounces. At a time of infirm gold prices in world markets, the Thai gold-prospecting concessions, more stringent than in many countries, were watched with interest.

Lead.—Mine output of lead concentrates as well as production of metallic lead substantially exceeded the old highs of 1986, after a sag in both concentrates

TABLE 22

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	1	56	—	Bangladesh 24; Malaysia 21.
Metal including alloys:				
Unwrought	—	8	—	Mainly to Malaysia.
Semimanufactures	1,738	1,443	—	Singapore 373; Hong Kong 317; Indonesia 250.
Antimony: Ore and concentrate	2,774	NA		
Chromium: Oxides and hydroxides value, thousands	—	$1	—	All to Singapore.
Columbium and tantalum: Ore and concentrate	13	NA		
Copper:				
Sulfate	192	NA		
Metal including alloys:				
Scrap	—	280	—	NA.
Semimanufactures	205	593	543	Japan 29.
Gold:				
Waste and sweepings kilograms	393	NA		
Metal including alloys, unwrought and partly wrought troy ounces	18,277	NA		
Iron and steel: Metal:				
Scrap	5,701	4,925	3	Japan 4,118; Singapore 188.
Pig iron, cast iron, related materials	—	100	—	NA.
Ferroalloys, unspecified	31	12	—	Australia 11.
Steel, primary forms	75	1	—	All to Oman.
Semimanufactures:				
Bars, rods, angles, shapes, sections	61,638	19,803	4,856	Hong Kong 7,369; Singapore 3,782.
Universals, plates, sheets	1,155	9,296	88	Hong Kong 4,484; Singapore 2,765.
Hoop and strip	—	7	—	Mainly to Singapore.
Rails and accessories	443	—		
Wire	1,022	329	9	India 174; Laos 49.
Tubes, pipes, fittings	167,673	195,911	127,715	Hong Kong 15,237; United Arab Emirates 10,394.
Castings and forgings, rough	—	44	—	All to Japan.
Lead:				
Ore and concentrate	54,110	51,247	—	Netherlands 17,200; Japan 16,894; Australia 5,733.
Metal including alloys:				
Unwrought	18	—		
Semimanufactures	95	19	—	Japan 15; Laos 2.
Manganese: Oxides kilograms	295	NA		

See footnotes at end of table.

TABLE 22—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Nickel: Metal including alloys, semimanufactures		1	[2]1	—	Mainly to Laos.
Silver:					
Ore and concentrate	kilograms	—	36,000	—	All to Malaysia.
Waste and sweepings[3]	do.	158	201	—	NA.
Metal including alloys, unwrought and partly wrought	value, thousands	$2	$477	—	Singapore $476.
Tin:					
Ore and concentrate		426	895	—	Republic of Korea 560; Malaysia 268.
Metal including alloys:					
Unwrought		15,029	13,670	210	Japan 5,052; Singapore 4,384.
Semimanufactures		4,090	1	—	All to Malaysia.
Titanium:					
Ore and concentrate		1,700	NA		
Oxides		—	1	—	All to Laos.
Tungsten: Ore and concentrate		922	1,179	736	West Germany 216; India 90.
Zinc:					
Ore and concentrate		110	2,396	—	Laos 650; Republic of Korea 200; Indonesia 196.
Oxides		167	298	—	Japan 109; Singapore 85; Sri Lanka 62.
Metal including alloys:					
Unwrought		27,825	17,616	—	China 7,869; Malaysia 1,728; Philippines 1,366.
Semimanufactures		808	1,053	—	Laos 957; Singapore 67.
Other:					
Ores and concentrates		5,509	35,477	632	Malaysia 27,126; Republic of Korea 5,660.
Ashes and residues		8,879	7,505	111	West Germany 2,868; India 2,028.
Base metals including alloys, all forms		96	124	—	Malaysia 60; Singapore 31.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$6	$12	—	Italy $8; United Kingdom $3.
Grinding and polishing wheels and stones		54	103	44	Malaysia 31; Hong Kong 10.
Asbestos, crude		7	6	—	All to Malaysia.
Barite and witherite		79,680	47,706	—	Indonesia 23,510; Singapore 9,069.
Cement		41,534	172,333	500	Philippines 53,700; Vietnam 41,900.
Chalk		—	42	—	All to Saudi Arabia.
Clays, crude		4,965	10,821	2	Malaysia 1,636; Indonesia 360; unspecified 8,477.
Diamond: Gem, not set or strung	value, thousands	$37,736	$58,547	$6,639	Hong Kong $18,062; Belgium-Luxembourg $17,070.
Diatomite and other infusorial earth		30	—		

See footnotes at end of table.

TABLE 22—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS--Continued					
Feldspar, fluorspar, related materials		183,683	211,186	—	Japan 74,376; Republic of Korea 29,510; Malaysia 9,884.
Fertilizer materials:					
Crude, n.e.s.		30	—		
Manufactured:					
Ammonia		5	3	—	Laos 1.
Nitrogenous		800	106	36	Laos 70.
Phosphatic		—	8	—	All to Laos.
Potassic		(4)	400	—	All to West Germany.
Unspecified and mixed	value, thousands	$82	$186	$3	Italy $112; Netherlands $21.
Gypsum and plaster		1,317,372	1,472,163	—	Japan 405,481; Indonesia 235,067; Hong Kong 100,050.
Phosphates, crude		1	72	—	All to Japan.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$270,988	$380,589	$84,846	Japan $100,861; Hong Kong $62,859.
Synthetic	do.	$10,063	$15,104	$3,383	Switzerland $3,846; Italy $3,318.
Salt and brine		54,489	60,578	—	Malaysia 46,320; Singapore 13,236.
Sodium compounds, n.e.s.: Carbonate, manufactured	kilograms	26,600	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		177	4,026	—	Bangladesh 510; Belgium-Luxembourg 39.
Worked		570	418	20	Fiji 84; Laos 51; Japan 37.
Dolomite, chiefly refractory-grade		—	20,167	—	Japan 20,000.
Gravel and crushed rock		1	268	—	Burma 229; Singapore 36.
Limestone other than dimension		7,490	5,877	—	Malaysia 4,771; Bangladesh 783; Singapore 282.
Quartz and quartzite		18,803	22,307	—	All to Japan.
Sand other than metal-bearing		8	—		
Sulfur:					
Elemental:					
Crude including native and byproduct		1,562	2,635	—	Philippines 1,923; Bangladesh 600.
Colloidal, precipitated, sublimed		406	27	—	Burma 24; Laos 3.
Sulfuric acid		53	202	—	Burma 144; Singapore 50.
Talc, steatite, soapstone, pyrophyllite		2,364	105	—	Malaysia 38; Indonesia 36.
Other:					
Crude		3,775	3,867	—	Philippines 3,200; France 378.
Slag and dross, not metal-bearing		4,656	5,826	—	West Germany 3,193; Netherlands 1,604; Japan 552.

See footnotes at end of table.

TABLE 22—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		—	5	—	All to Indonesia.
Carbon black		7,385	7,456	—	India 4,330; Indonesia 1,965; Japan 412.
Coal: Anthracite and bituminous		756	1,170	—	Malaysia 900; Pakistan 162; Indonesia 72.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	5,571	4,019	3,642	Unspecified 376.
Mineral jelly and wax	value, thousands	—	$1	—	All to Singapore.
Kerosene and jet fuel	thousand 42-gallon barrels	472	1,999	—	Malaysia 11; Singapore 9; unspecified 1,171.
Distillate fuel oil	do.	(4)	145	—	All to Singapore.
Lubricants	do.	5	12	—	Indonesia 6; Hong Kong 2.
Residual fuel oil	do.	91	186	—	Japan 139; Singapore 47.
Bitumen and other residues	do.	(4)	(4)	—	All to Indonesia.
Bituminous mixtures	do.	(4)	(4)	—	All to Hong Kong.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Excludes unreported quantity exported to United Kingdom valued at $3,000.
[3] May include other precious metals.
[4] Less than 1/2 unit.

and the metal in 1987. During 1987, Metallgesellschaft AG of the Federal Republic of Germany planned to reduce production of lead and mixed bulk concentrate, after operating losses in 1985. The company, meanwhile, pressed the Thai Government for easier treatment on royalties and taxes, which had been raised by 87% at the beginning of 1987. With the reduction of taxes and the coming on-stream of the Thai Lead Metal Co. 12,000-ton-per-year lead smelter in Kanchanaburi, rescheduled for April 1988 after an environmental dispute, the outlook for the lead industry in Thailand improved markedly.

Tin.—The 1985 collapse of the world tin market continued to exert its depressing effect on the tin producers of the world, including Thailand. As the direct result of the International Tin Council's (ITC) support of prices at artificially high levels, production escalated, demand shrank, stockpiles and inventories grew and, in October 1985, the ITC was unable to continue its support of unrealistic pricing. Free-market forces immediately came into play, and tin production dwindled. Producers disappeared as world consumption gradually absorbed the available excess at much lower prices, the latter having dropped from a peak of approximately $17,000 per ton in 1985 to about $6,000 per ton in 1986. A better tin market emerged in 1988 in the form of a significant increase in world demand for tin, greatly reduced inventories, the absence of many former producers, and a consequent firmer tone in prices. Some quotes were entered in the $10,000 per ton range in a market that was expected to recover further.

Thailand's participation in market improvement, in support of the ATPC's broader effort to restore the world market, included a moratorium on the issuance of tin-mining licenses in order to reduce the overhang of inventories while consumption proceeded apace. By the end of 1988, the number of Thai tin mines still open, 225, represented fewer than one-half the total operating mines before the 1985 crash. Apprehension concerning future market strength, high startup costs for mines, and attractive investment opportunities in other sectors such as real estate, tourism, rubber, oil palms, and shrimp farming, were primary causes of the sluggishness in production and exports. A burgeoning tourist industry in such areas as Phuket generated environmental complaints and brought tin miners into contention with the Government over constraints on offshore dredging for cassiterite. Not wanting to destroy

TABLE 23

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals value, thousands	—	$2	$1	NA.
Aluminum:				
Ore and concentrate	11,491	21,714	—	China 21,676.
Oxides and hydroxides	17,605	19,960	239	Japan 14,670; China 1,775.
Ash and residue containing aluminum	51,523	NA		
Metal including alloys:				
Scrap	420	1,499	—	Laos 926; Singapore 335; Kuwait 102.
Unwrought	47,461	53,735	836	Australia 24,319; Canada 13,785.
Semimanufactures	3,641	5,516	1,189	Japan 1,780; West Germany 562.
Antimony:				
Ore and concentrate	3,002	NA		
Metal including alloys, all forms	12	NA		
Arsenic: Oxides and acids	79	NA		
Chromium:				
Ore and concentrate	2,755	174	—	Netherlands 90; Belgium-Luxembourg 84.
Oxides and hydroxides	419	549	100	West Germany 253; U.S.S.R. 89.
Metal including alloys, all forms kilograms	129	NA		
Cobalt				
Oxides and hydroxides	7	13	3	Belgium-Luxembourg 7.
Metal including alloys, all forms kilograms	229	NA		
Columbium and tantalum: Metal including alloys, all forms, tantalum value, thousands	$10	$21	—	All from Japan.
Copper:				
Matte and speiss including cement copper	149	50	—	All from Chile.
Metal including alloys:				
Scrap	10	531	3	Laos 398; Kuwait 76.
Unwrought	20,080	27,303	5	Zambia 14,391; Japan 5,012.
Semimanufactures	6,707	13,765	296	Japan 6,034; Indonesia 2,643.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	130,649	NA		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	81	120	—	All from Malaysia.
Metal:				
Scrap	555,114	903,323	99,669	Brazil 106,755; West Germany 97,893.
Pig iron, cast iron, related materials	16,910	44,751	—	China 33,490; Japan 5,797; Indonesia 4,500.
Ferroalloys:				
Ferrochromium	197	NA		
Ferromanganese	2,980	3,586	—	France 2,693; Japan 374; China 230.

See footnotes at end of table

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Ferroalloys—Continued				
Ferrosilicomanganese	2,265	NA		
Ferrosilicon	3,525	NA		
Silicon metal	9	NA		
Unspecified	515	6,748	79	China 3,093; Norway 2,557.
Steel, primary forms	430,325	878,170	607	Mexico 125,854; Algeria 120; Brazil 86,045.
Semimanufactures:				
Bars, rods, angles, shapes, sections	204,984	308,644	651	Japan 165,370; United Kingdom 26,164; Republic of Korea 18,766.
Universals, plates, sheets	933,501	1,225,942	11,556	Japan 747,769; East Germany 131,187; West Germany 65,597.
Hoop and strip	14,754	99,977	40	Japan 92,278; West Germany 1,035.
Rails and accessories	413	2,459	—	Poland 1,728; Republic of Korea 438; Belgium-Luxembourg 50.
Wire	8,670	18,238	38	Japan 10,884; Republic of Korea 2,911.
Tubes, pipes, fittings	31,345	30,554	543	Japan 21,497; United Kingdom 2,820.
Castings and forgings, rough	45	35	—	Japan 18; Republic of Korea 17.
Lead:				
Oxides	393	585	—	Australia 304; China 123; West Germany 117.
Metal including alloys:				
Scrap	1,095	3,686	19	Kuwait 2,115; Japan 588.
Unwrought	9,613	13,453	—	Australia 7,935; Japan 1,377; Republic of Korea 1,374.
Semimanufactures	226	44	(2)	Peru 26; Australia 6.
Magnesium: Metal including alloys, all forms	59	115	10	France 25; Norway 20.
Manganese:				
Oxides	933	1,207	—	Japan 446; China 443; Australia 256.
Metal including alloys, all forms	10	—		
Mercury 76-pound flasks	402	319	(2)	West Germany 203.
Molybdenum: Metal including alloys, all forms value, thousands	$56	$32	—	Belgium-Luxembourg $11; West Germany $8.
Nickel:				
Matte and speiss	8	18	—	All from Canada.
Metal including alloys:				
Scrap	149	—		
Unwrought	517	776	5	Canada 329; Norway 218.
Semimanufactures	438	1,398	459	West Germany 472; Republic of Korea 335.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$860	$1,164	—	Japan $1,157.
Silver:					
Ore and concentrate[3]		100	350	—	All from China.
Waste and sweepings[3]	value, thousands	—	$1	—	All from United Kingdom.
Metal including alloys, unwrought and partly wrought	do.	$11,993	$8,973	$109	Australia $2,515; Hong Kong $2,290.
Tin: Metal including alloys, all forms		11	10	—	Japan 9.
Titanium:					
Ore and concentrate		485	NA		
Oxides		1,708	2,210	22	Australia 612; United Kingdom 452; Japan 424.
Tungsten: Metal including alloys, all forms		4	3	—	Japan 1; West Germany 1.
Zinc:					
Oxides		376	640	2	China 263; Japan 69.
Blue powder		70	NA		
Metal including alloys:					
Unwrought		4,695	4,792	—	Australia 4,252; Belgium-Luxembourg 318.
Semimanufactures		340	647	5	Norway 207; United Kingdom 169.
Other:					
Ores and concentrates		2,221	13,318	—	Malaysia 7,001; Burma 4,245; Australia 1,324.
Ashes and residues		70	278	224	Singapore 54.
Base metals including alloys, all forms		31	74	2	Japan 39; China 10.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		1,997	7,287	63	Indonesia 4,030; Netherlands 1,599; India 695.
Artificial:					
Corundum		40	63	—	Italy 44; Japan 18.
Silicon carbide		605	NA		
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$94	$137	$13	Belgium-Luxembourg $62; Ghana $20.
Grinding and polishing wheels and stones		1,388	1,701	7	Japan 468; Chile 341.
Asbestos, crude		49,663	71,407	12,409	Canada 30,491; Zimbabwe 7,516; Greece 4,368.
Barite and witherite		—	8	—	China 5; Japan 3.
Boron materials: Oxides and acids		181	200	154	West Germany 30; United Kingdom 14.
Cement		3,486	3,248	10	Singapore 2,124; France 897.
Chalk	kilograms	1,725	1	1	
Clays, crude		28,254	25,939	9,192	Indonesia 6,364; United Kingdom 3,365.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Cryolite and chiolite		13	11	—	All from Japan.
Diamond:					
Gem, not set or strung	value, thousands	$95,614	$172,184	$13,393	Belgium-Luxembourg $58,173; India $45,711.
Industrial stones	do.	—	$23	—	All from Belgium-Luxembourg.
Diatomite and other infusorial earth		153	372	352	China 20.
Feldspar, fluorspar, related materials		1,122	4,039	—	Japan 533; Canada 401; Italy 331.
Fertilizer materials:					
Crude, n.e.s.		43	338	17	Unspecified 320.
Manufactured:					
Ammonia		5,506	8,593	—	Malaysia 7,097; Indonesia 1,171.
Nitrogenous		446,554	428,378	27,512	Japan 273,475; Belgium-Luxembourg 40,500.
Phosphatic		500	5,754	3,100	Netherlands 1,097; Belgium-Luxembourg 1,000.
Potassic		62,970	89,189	8,675	U.S.S.R. 39,024; West Germany 12,480.
Unspecified and mixed		808,341	788,543	35,948	Republic of Korea 240,091; Philippines 129,510.
Graphite, natural		827	1,138	(2)	China 641; Republic of Korea 232; Sri Lanka 170.
Gypsum and plaster		933	22,231	390	Hong Kong 15,401; Japan 5,545.
Iodine	kilograms	3,022	NA		
Lime		60	72	—	United Kingdom 60.
Magnesium compounds:					
Magnesite, crude		5,916	4 22,051	—	China 17,199; Japan 4,258.
Oxides and hydroxides		8,522	NA		
Mica:					
Crude including splittings and waste		176	274	20	India 111; Malaysia 60.
Worked including agglomerated splittings		34	46	(2)	Japan 30; Belgium-Luxembourg 12.
Phosphorous, elemental		35	NA		
Pigments, mineral:					
Natural, crude		155	NA		
Iron oxides and hydroxides, processed		2,417	3,141	274	West Germany 1,652; Japan 362.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$40,888	$78,063	$8,953	Australia $17,698; Sri Lanka $16,319.
Synthetic	do.	$6,088	$10,415	$2,345	Switzerland $1,603; India $303.
Pyrite, unroasted		8	16	(2)	Italy 8.
Salt and brine		937	1,160	99	United Kingdom 571; West Germany 243.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Carbonate, manufactured		110,410	97,366	22,978	Romania 22,723; Belgium-Luxembourg 15,989.
Sulfate, manufactured		27,440	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,868	1,067	—	China 491; Italy 383; Republic of Korea 90.
Worked		962	1,419	1	Italy 1,318; Belgium-Luxembourg 55.
Dolomite, chiefly refractory-grade		237	468	—	All from Norway.
Gravel and crushed rock		773	1,827	—	France 1,244; China 558.
Limestone other than dimension		(2)	35	—	Unspecified 35.
Quartz and quartzite		340	209	—	Italy 128; China 50.
Sand other than metal-bearing		166	241	109	Japan 127.
Sulfur:					
Elemental:					
Crude including native and byproduct		59,895	59,013	—	Canada 25,627; Singapore 18,994; China 13,798.
Colloidal, precipitated, sublimed		120	224	(2)	West Germany 140.
Dioxide		19	—		
Sulfuric acid		3,047	3,139	38	Japan 2,990; United Kingdom 57.
Talc, steatite, soapstone, pyrophyllite		22,117	26,518	98	China 15,722; Republic of Korea 9,978.
Other:					
Crude		12,368	12,887	—	China 2,943; West Germany 1,168; unspecified 7,350.
Slag and dross, not metal-bearing		38	1,324	—	Japan 1,217; United Kingdom 100.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		33	42	42	
Carbon black		4,105	4,748	159	China 690; Philippines 466; Singapore 413.
Coal: Anthracite and bituminous		182,584	254,415	—	Australia 171,923; Indonesia 43,251; China 35,034.
Coke and semicoke		39,115	57,088	—	Japan 41,850; China 14,162.
Peat including briquets and litter		—	2	—	All from West Germany.
Petroleum:					
Crude	thousand 42-gallon barrels	51,880	54,685	—	Malaysia 16,046; Brunei 12,150; United Arab Emirates 7,818.
Partly refined	do.	r1,237	NA		
Refinery products:					
Liquefied petroleum gas	do.	660	1,429	(2)	Kuwait 539; Venezuela 309; Indonesia 226.
Gasoline	do.	107	2,533	—	Singapore 2,379; Philippines 112.
Mineral jelly and wax	do.	94	101	11	China 62; Japan 9.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Kerosene and jet fuel	thousand 42-gallon barrels	1,273	2,737	19	Singapore 2,626; Philippines 91.
Distillate fuel oil	do.	14,239	19,843	—	Singapore 17,385; Malaysia 1,577.
Lubricants	do.	1,383	1,888	35	Singapore 1,030; China 357.
Residual fuel oil	do.	521	3,709	(2)	Singapore 1,880; Kuwait 1,344.
Bitumen and other residues	do.	51	40	—	Singapore 28; Japan 7.
Bituminous mixtures	do.	10	23	(2)	United Kingdom 19; Republic of Korea 3.
Petroleum coke	do.	28	31	(2)	Burma 30.

[r] Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] May include other precious metals.
[4] Includes oxides and hydroxides.

its leading metals industry and source of export earnings, the Thai Government maintained low royalties on tin in order to encourage further production from the remaining mines. By yearend, however, these measures were not successful enough to meet the export quota of 19,000 tons for Thailand under the ATPC supply rationalization scheme.

Meanwhile, small tin-mining companies in northern Thailand in the vicinity of Chiang Mai were watching market prices intently. One operation producing about 5 tons per month, by hydraulic techniques and gravity separation, stated that it would not be profitable at current prices until it achieved an output of at least 10 tons per month. In this area, 20 tons per month would have ranked as a large mine. Because production was insufficient to support a smelter in northern Thailand, tin concentrates from as many as 24 mines in this region were taken to Chiang Mai for grading and stockpiling and then shipped in 13-ton loads by 10-wheeled truck to Phuket, roughly 1,000 kilometers to the south.

Zinc.—In 1988, for the first time, the value of Thai zinc production exceeded that of tin, the longtime leader in the mineral industries of Thailand. The production of zinc ore at the Mae Sod Mine for Padaeng Industry Co.'s (PDI) ultramodern zinc refinery was about 420,000 tons, valued at more than $108 million for 1988, a 15% increase over that of 1987. Tin, however, still represented the largest share of Thailand's export revenues.

The PDI refinery, the world's first electrolytic zinc refinery to treat silicate zinc ores[75] (hemimorpnite), was operated in conjunction with the only economic zinc deposit known in Thailand. Such a refinery, by using chemical rather than thermal methods for reduction and processing of the ore, avoided the problems of smokestack effluent and the release of sulfur compounds into the atmosphere. This zinc mine and refinery, a milestone in engineering design, process technology, and minimal environmental impact, set a standard for the industry, and reflected credit on the Thai-Belgian team that brought it into being.

Although originally announced to have a designed capacity of 60,000 tons of refined zinc per year, the capacity was increased by approximately 10,000 tons per year. This expansion resulted in the production of approximately 68,600 tons of zinc in 1988.

Another new feature of the PDI operation was the establishment of a zinc-alloy plant in 1988. During the year, 4,086 tons of Zamag No. 3 zinc alloy was reported to have been produced, all for domestic consumption.

Because of the good grade of their smithsonite-hemimorphite ore and agreeably high zinc prices, PDI's only problem seemed to have been the quantity of reserves, at about 4.5 million tons. Further exploration was warranted for determination of further reserves. PDI also contemplated a cadmium-recovery operation utilizing their zinc tailings to extract

as much as 1,000 tons per year of refined cadmium for marketing to the nickel-cadmium battery manufacturers.

Other Metals.—The mineral rutile, composed of titanium dioxide, is added to Table 1 for 1988 because of its increasing (up 39%) production along with leucoxene (up 125%) at the expense of ilmenite production, down sharply (37%). This shift of emphasis in the production of titanium minerals, in all probability, simply reflected an attempt to exploit all possible sources for a strong market in titanium-based pigments for paint, in that production of ilmenite itself had been up manyfold in 1987 compared to that of 1986. As byproducts of tin mining in offshore dredging, the value of these titanium minerals became apparent as various methods of separation and classification were applied.

Xenotime production increased nearly 240% as output of this source of yttrium, also a detrital mineral like cassiterite (tin), ilmenite, leucoxene, and rutile, swung upward again. Although not approaching the 1985 high of 158 tons, the 1988 value of 101 tons suggested that superconductivity research had encouraged interest in this phosphate of yttrium.

Zirconium ore and concentrate production climbed from 199 tons in 1983 to 5,098 tons in 1988. This rise reflected the steadily increasing interest in zircon metal as a material suited to specialized uses in nuclear reactors and other high-temperature applications. Zircon, as a fairly common detrital mineral, was a byproduct of tin dredging that could be separated in response to demand.

Industrial Minerals.—**Barite.**—Production of barite was up about 22%, a modest recovery from the extreme low output of 1987. At a little over 40,000 tons, the 1988 production was nowhere near the 1985 high of about 231,000 tons, which was aimed primarily at satisfying the demand for drilling muds for the petroleum industry. Although some forecasts implied a sharp increase in export demand for Thai barite, the world market for crude oil has demonstrated a price instability of notorious proportions. However, petroleum exploration and development in China, Thailand, Vietnam, and other Asian areas, both offshore and onshore, was probably as vigorous as in any other part of the world, so Thai barite mining stood to gain as drilling requirements increased.

Total recovery of the Thai barite industry had a long way to go in 1988. From 51 active mines, employing more than 1,700 workers in 1985, the number of active mines decreased to 31, employing 361 workers. Some mines were worked by small family groups who endeavored to maintain a subsistence-level standard of living.

Some sources conceded that China preempted a part of the Thai barite export market by offerings at lower prices, but these sources believed that China could not compete on small-scale orders in the region.

Cement.—For all practical purposes, a bellweather of the mushrooming development and expansion of Thailand was cement production, which once again registered a new high, and broke through the 10-million mark to more than 11.5 million tons, up 17% from 1987. In the past, exports have been very small in comparison to domestic consumption of hydraulic cement. Preliminary information is that no cement was exported in 1988.

The Thai cement industry depended heavily on petroleum fuel (mostly natural gas) from domestic production for this energy-intensive product. The Thai Minister of Science, Technology, and Energy was quoted as believing that if the cement industry could switch to lignite fuel, it could produce the lowest cost cement in the world.

Fertilizer Materials.—There were no significant developments in 1988 in the ongoing struggle to construct Thailand's first nitrogen and compound fertilizer plant at Map Ta Put, in Rayong Province. It was planned to have yen-loan financing and construction by a consortium led by Chiyoda Chemical and Engineering and Construction Co. of Japan. In 1987, the reason given for delay was the continuing strengthening of the yen in the face of low market pricing of urea and the relatively high cost of domestic natural gas as a raw material. No significant relief from the combination of these factors occurred in 1988, therefore, the postponement may have been permanent. Total renegotiation remained a possibility in the light of further demand analysis for fertilizers and reconciliation of costs of raw materials and financing.

Phosphate rock production climbed sharply to an output of about 8,350 tons for the year, up 85% over that of 1987. It was not exported in the past because of the severity of domestic demand, so that such an upsurge in production boded well for Thai agriculture.

Although Southeast Asia was generally very much in need of potassium fertilizers, potash (and accompanying phosphate) deposits in northeast Thailand still awaited consummation of agreements on exploration and exploitation. Protracted discussions with potential foreign joint venturers have reached no conclusion after several years. Both Placer Dome of Canada and DHP-Utah International of the United States were interested in acquiring the right to explore for, and subsequently produce, potash deposits in Udon Thani and, toward the east, in Sakon Nakhon and Nakhon Phanom Provinces of the northeast. A press release by the Thai Department of Mineral Resources broached the possibility of an ASEAN project to develop potash resources in Chaiyapum Province, also in the northeast but not contiguous with the aforementioned three provinces.

Gypsum.—The production of gypsum climbed steadily over the past few

years, and it was emerging as one of the first-rank industries of Thailand. Export demand as well as domestic requirements pushed gypsum production up 50% over that of 1987 to 4.5 million tons in 1988. Between 400,000 and 500,000 tons of the mineral was to go to gypsum board for the domestic market, and a small amount of board was exported to Japan. Based on competitive pricing, gypsum products rose to second place among mineral exports in order of value, exceeded only by tin.

Other Industrial Minerals.—Fluorspar production declined about 25% to 76,000 tons from 102,000 tons in the midst of competition from China. Feldspar output was up sharply to almost 294,000 tons, an increase of 74% over that of 1987, as export demand for ceramic use increased. The proportion of potassium to sodium feldspar diminished steadily to less than 2% since 1983. Limestone to feed Thailand's flourishing cement industry was up 24% to more than 14 million tons in 1988.

***Mineral Fuels.*—Anthracite.**—A discovery of anthracite deposits in Loei Province in the northeast made Thailand the second nation in Southeast Asia, with Vietnam, to locate deposits of this high-rank coal. The material was mined and marketed to water authorities for use in removing impurities by filtration (and possibly chemical reduction) of drinking water.

Lignite.—After surpassing tin in 1986 as Thailand's highest value mineral commodity, the gap widened in 1987 as lignite climbed to a new high, up 5% to 7.3 million tons in 1988, worth about $150 million. During the same period tin production more or less stagnated. The Thai Government prohibited the export of lignite, and directed instead that it go to support the generation of power in Thailand.

Lignite was mined chiefly at Mae Moh in Lampang Province, where it fueled seven on-site electric powerplants. Another seven plants were under construction or scheduled for completion by 1995. Lignite mining was also under development on a smaller scale in Krabi Province, and lignite deposits, including substantial reserves, were under study far to the south at Sabai Yoi in Songkhla Province. By the year 1990, lignite production in Thailand was expected to be close to 11 million tons.

Thai Government policy endorsed natural gas as fuel for the generation of electric power, but the increased demand for electricity created the necessity for using both fuels. Environmental considerations have begun to affect the development and burning of lignite in parts of the country.

Natural Gas.—The Thai Government continued to encourage exploration for new gas reserves, along with the interest in crude, as the inevitable decline curves came into significance on earlier discoveries. Gas was a convenient fuel for electric-power generation as well as for industry in general, and the prospect of still undiscovered reservoirs, especially in the Gulf of Thailand, focused attention on the so-called "B" structure a little more than 161 kilometers southeast of the Erawan and Baanpot Fields. On the premise that the original conditions of offering of the "B" structure were too stringent, the Petroleum Authority of Thailand (PTT), bought back the tract from Texas Pacific in 1987 and prepared in 1988 to revise these conditions to attract serious negotiations.[76]

Although concern has been expressed about natural gas availability, actual gross production in 1988 reached a new high of almost 212 billion cubic feet, with an official estimate of 14.7 trillion cubic feet of gas reserves identified. These reserves were mostly offshore in tracts controlled by Unocal and PTT but also included acreage in northeast Thailand controlled by Esso Exploration. A comparison[77] of the composition of Thai onshore with offshore natural gas is presented in the text table.

Constituent		Offshore	Onshore
C1	Methane	65.95	95.33
C2	Ethane	8.35	.64
C3	Propane	5.12	.3
C4	Butane	2.65	.1
C5/C5+	Pentane, etc.	1.81	.02
CO_2	Carbon dioxide	14.6	1.84
N_2	Nitrogen	1.48	1.75
H_2S	Hydrogen sulfide	.00	.02
TOTALS:		**99.96**	**100.00**

Time and temperature have provided for the maturation of onshore gas to a composition essentially of methane, having no obvious potential for production of condensates. Offshore gas from the Gulf of Thailand was clearly strong in the higher molecular weight hydrocarbons, indicating a relatively high proportion of condensates, and was also high in carbon dioxide. Taken together, these data showed a distinctly poorer degree of maturation and suggested, at least, the presence of crude in the geological vicinity.

Crude Petroleum.—Production of crude in Thailand increased to 7.4 million barrels in 1988 along with another 5.4 million barrels of natural gas condensates, neither figure representing the high value for the past 5 years. Reserves were placed at about 283 million barrels of crude and natural gas liquids.

Exploration for new pools and new fields proceeded apace. Appraisal or development wells were drilled in several locations, while the Thai Government grappled with problems of definition and terms of concessions for exploration and production.[78] The permissible area of onshore concession blocks was reduced from 10,000 to 4,000 square kilometers, with certain exceptions for high-cost fields. The

maximum area allowed any specific concessionaire was to be reduced from 50,000 to 20,000 square kilometers, except for offshore areas in depths greater than 200 meters. The maximum exploration period was to be decreased from 8 to 6 years, and renewals were to be reduced from 4 to 3 years. The maximum production period after the end of the exploration period was to be reduced from 30 to 20 years. Other changes with respect to relinquishment, production obligations, and royalties (the latter on a new sliding scale) were to go into effect. In general, the new rules were more stringent but would seem to allow for more flexibility on a case-by-case basis where warranted. Other changes were anticipated by direction of the PTT.

Trade papers report[79] that in April Unocal gauged its Surat No. 2 well in the Gulf of Thailand at 1,900 bbl/d of crude and condensate plus nearly 25 million cubic feet per day of gas. Additional drilling was scheduled for the coming months. In July, in its first wildcat, Petrocorp Exploration Thailand Ltd. (New Zealand) found 480 bbl/d of crude in its Vichienburi No. 1 well in Petchabun Province in central Thailand. This company restructured the ownership of this block, SW1, retaining 57.5% ownership as operator, and assigned 15% each to Mimex Co. and Kirkland Resources PLC of the United Kingdom and 12.5% to Northern Michigan Electric Corp. (NOMECO) of the United States. In December, Premier Oil Pacific Ltd.'s Songkhla No. 1 well in the Gulf of Thailand tested at 1,400 bbl/d of crude.

Because of higher oil prices on world markets at the conclusion of 1988, interest in petroleum exploration in Thailand was keen.

VIETNAM[80]

Introduction

Continued successful development of the fledgling petroleum industry far outweighed the other mineral sectors. Three years ago all of Vietnam's petroleum needs were imported at considerable cost, both politically and directly, to the economy. It appeared that offshore oil production should furnish the country's total petroleum needs by the early 1990's and could leave a small surplus to help pay for expensive imports.

Placer gold mining became an interesting item in the press during the year. Apparently a policy change in the purchasing regulations for gold by the Government's Precious Metals Corp. sparked a minigoldrush in the highlands of the north and central provinces.

The coal sector has continued to have problems in production, quality, transportation, and administration.

In the December session of the National Assembly, the Vice Premier painted a bleak picture of the economy and called for the abolition of free health care and education as well as further expansion of the private sector. The country's social, economic, and financial positions did not improve in 1988.[81] Inflation remained serious in 1988, although it was lower than in 1987. The Government did not divulge the inflation rate, but a top Vietnamese economic adviser from Ho Chi Minh City stated inflation was running between 700% and 1,000% per year. However, a banking reform was underway, after which the central bank would retain control of the money supply, and smaller commercial banks would be established to administer credits.[82]

There were some encouraging developments. GNP in 1988 increased 5.4% over 1987. Industrial output was up 8.9%. Production of electricity and cement rose 15%, sulfuric acid 39%, and chemical fertilizer 15%. Export value increased by 13.5%. Official plans for 1989 were as follows: GNP to increase 7.6%; national income to increase 8.2%; industrial output to increase 10%; and export value to increase 15% over that of 1988.

The most important mineral exports, in descending order of value, were coal, tin, phosphate rock, and a small amount of chromite. About 700,000 tons of crude oil was exported for credit toward imports and to repay debts.

The major mineral imports were refined petroleum products, fertilizers, semifinished and finished metals, equipment, and machinery, also gypsum for the cement industry.

Commodity Review

Metals.—**Gold.**—Reports of widespread placer gold mining in Bac Thai, Cao Bang, Lai Chau, Ha Son Binh, and Hoang Lien Son Provinces were prevalent in the press during the year. A Hanoi newspaper reported that tens of thousands of people in Bac Thai Province were prospecting for gold. The General Department of Mines and Minerals reportedly estimated that 700,000 persons were panning for gold in Vietnam.

The sudden interest in gold prospecting and panning was probably caused by a Government policy change, which essentially allowed the Precious Metals Corp. to buy gold without regard to the sources or amount of gold involved. Gold production and sales were to be controlled and taxed by a variety of regulations. In Bac Thai, the center of most of the activity, persons from outside the province were not allowed to mine gold, and a person from one district or village was not permitted to go to another district to mine gold. Individuals and groups in the localities must pay a license tax of $0.75 to $1.00[83] per month, as well as other kinds of taxes, and must sell to the state 20% to 25% of the gold mined, at the prescribed prices. The remainder was to be sold at a price between 5% and 10% below market.

In a country with serious underemployment and a precarious economy, the Government's rules were not being strictly adhered to. The press complained of the disruptive effects of the prospecting. These effects included people leaving their jobs and neglecting

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TABLE 24

VIETNAM: PRODUCTION OF MINERAL COMMODITIES[1 2 3]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[e]	1988[p]
Bauxite: Gross weight[e]		5,000	6,000	6,000	6,000	6,000
Cement, hydraulic[e]	thousand tons	1,100	1,300	1,540	[4]1,512	1,500
Chromium: Chromite[e]		16,000	15,000	15,000	15,000	14,000
Clays: Kaolin[e]		1,000	1,000	1,000	1,000	1,000
Coal: Anthracite	thousand tons	5,840	6,200	6,007	6,500	[e]5,000
Gypsum[e]		25,000	25,000	25,000	25,000	25,000
Iron and steel: Metal:[e]						
Steel, ingot	thousand tons	100	110	110	110	115
Steel, rolled	do.	40	50	50	50	50
Nitrogen: N content of ammonia		([5])	([5])	([5])	([5])	([5])
Petroleum: Crude[e]	thousand 42-gallon barrels	—	—	200	600	5,475
Phosphate rock:[e]						
Gross weight	thousand tons	200	[5]516	530	300	330
P_2O_5 content	do.	66	170	175	105	115
Salt	do.	[e]800	379	[e]450	[e]229	[e]300
Tin:[e]						
Mine output, Sn content		500	600	650	680	700
Metal, smelter		475	570	620	645	600
Zinc:[e]						
Mine output, Zn content		7,000	5,000	5,000	5,000	5,000
Metal, smelter, primary		6,000	4,200	4,200	4,200	4,200

[e] Estimated. [p] Preliminary.

[1] Table includes data available through Aug. 18, 1989.

[2] In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3] In addition to the commodities listed, iron ore was mined in the past and pig iron was produced at industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to allow formulation of reliable estimates of output levels. Similarly, data on output of crude construction materials and natural gas are not available, and no basis is available to make reliable estimates of output levels.

[4] Reported figure.

[5] Nitrogen (N content of ammonia) production capacity of the country's only known plant is 54,000 tons per year; it is not known at what output level the plant is operating.

their farming duties. "The evils of gambling, prostitution, fighting, speculation, and black marketeering have developed." Government cadres were reportedly bribed and corrupted.[84] Despite the apparent disruptions to local economies and the somewhat chaotic conditions, the Council of Ministers issued a directive to all localities concerned to step up placer mining in order to increase production in 1989 by several times over that of 1988.[85]

Production of gold in recent years has apparently been approximately 36 ounces per year. This increased to 842 ounces in 1987 and 2,407 ounces in 1988. The latter figure is the reported purchase by the Precious Metals Corp. It was generally assumed that somewhat more was actually recovered during the period. The panned material averaged 93% Au content.

On the more official end of the mining ladder, the Australian company Covictory Investment Ltd. reportedly acquired 100% interest in the former Bong Mieu gold mine, 75 kilometers south of Da Nang. The Bong Mieu deposit consists of three parallel veins of nearly solid auriferous pyrite. The reserves were estimated at 160,000 ounces of gold and had excellent potential for more than that. The property was first mined in the 7th century; however, the Vietnamese entered the area in the 15th century and mined intermittently until the 19th century. The French took over in 1885 and operated it until World War II. Due to the military and political situation, it has been abandoned since then. During the French tenure, 112,425 ounces of gold were extracted at an average grade of about 0.23 ounce per ton. The new company planned to operate at a rate

of 16,000 troy ounces per year after an initial investment of $5 to $6 million.[86]

Iron and Steel.—The Gia Sang rolling plant at Thai Nguyen steel complex was producing finished products at a 33,000-ton-per-year rate after 12 technical innovations were introduced through August 1988. At the same location, an Indian-Vietnamese cooperative project was in the early stages of development. The work was apparently part or all of an electric-arc-furnace steel facility planned for Thai Nguyen. The Government dropped plans for a blast furnace several years ago because of the prohibitively high capital cost and lack of domestic coking coal.

Tin.—The tin industry was getting help from two sources during the year. The United Nations Development Program was assisting the Ministry of Mechanical Engineering and Metallurgy to establish and operate a laboratory for developing tin-ore-processing technology for the different types of tin deposits in Vietnam. Total budget for the project was $910,000.

The Vietnamese radio carried a news item on the Soviet assistance being given to the tin industry at Qui Hop in Nghe Tinh Province. The main facility was to be a 650-ton-per-year tin smelter. The broadcast stated that a hospital, housing, road improvements, and cultural facilities for the Vietnamese and Soviet workers had been built. Although announced in a positive vein, the story, in effect, admits to a serious delay in a project started long ago. The support facilities were first reported as under construction in 1981, and an agreement for the construction of the smelter was signed with the U.S.S.R. in 1984.[87]

Industrial Minerals.—The country's second superphosphate fertilizer plant was being constructed on schedule in Long Thanh, east of Ho Chi Minh City. The 45,000-ton-per-year plant was scheduled to begin production by the end of 1990.

The Council of Ministers issued a directive urging that all quarries in the country be operated for the good of the entire country and not just their local areas. The Ministry of Building indicated that intensive investment would be needed to meet the plan of increasing the 1988 production of 4.9 million tons to 5.5 million tons in 1990.

The Institute of Industrial Chemistry has reportedly begun producing rutile concentrate from the mineral sands deposits along the coasts of Binh Tri Thien, Nghia Binh, and Phu Khanh Provinces. Zircon was already being separated on a limited trial basis for the metal casting and ceramics industry.

***Mineral Fuels.*—Coal.**—The coal sector has continued to have serious problems which persisted despite urgent and varied efforts to correct them, during the last several years. According to the Ministry of Energy, "the coal sector's activities have met with great difficulties and is operating at a great loss." Production quotas were frequently not met. Costs have increased to the point where some consumers can no longer afford the grade of coal they need. Transportation inadequacies have left huge piles of washed coal deteriorating at the mines while customers experience shortages. The quality of the coal delivered was often well below that needed for a particular use.

In October, the Council of Ministers directed the Minister of Energy to, "closely guide various units of the coal sector in reorganizing production, renovating management, and promptly improving production output, quality, and efficiency of the entire sector." Several corrections were to be tried. Only the most critical industries would be entitled to the special reduced price, such as powerplants, trains, and medical glassware. Even those would be eliminated as soon as possible. Income from coal exports would be repaid to the coal industry rather than foreign debts. Cost accounting was to be strict and every effort made to ensure that the coal industry did not operate at a loss as it has for the past several years. Some of the coal-dedicated sections of railroad roadbed and tracks were improved, but additional work was urgently needed.

Policy changes in the management of the mines were being tried in order to put the responsibility for operations squarely on the mine director. At the 500,000-ton-per-year Nui Hong coal mine, the choice of a new director was made in June by a competitive examination. The five candidates were ranked on the basis of their individual ideas for running the mine and improving the working conditions and morale of the miners. The board of examiners was headed by a Vice Minister of Energy, and the choice was made by secret ballot. Selections in the past have been made on less than objective and impersonal grounds and have probably been a major factor in the industry's problems. In the future, it was announced, directors of enterprises that fail to full full production plans for 2 consecutive years will be relieved of their posts and replaced by new ones to be selected through similar tests but developed by the individual companies concerned.[88]

Natural Gas.—The small natural gas field discovered several years ago in Thai Binh Province, southwest of Hanoi, has spawned a number of mineral related industries that are beginning to yield positive results to the economy. The field produced 175 million cubic feet of gas in 1988 under the Oil and Natural Gas General Department.

All of the new plants were in Tien Hai District. The Tien Hai Pottery Enterprise began production of household china, insulators, and art and handcraft pottery for export. Capital investment was $100,000, and the plant employed more than 110 workers. The Glass Enterprise apparently started production early in the year. Its output consisted of glasses, bottles, vases, and

light bulbs. Costs using natural gas instead of coal were reduced from $0.15 to $0.006 per kilogram of molten glass and the quality was considerably improved as well. The Long Hau Brick and Tile Enterprise tripled production of basic bricks after changing from wood and coal to natural gas. It also introduced a new glass enamel construction brick, which was not feasible when using coal as fuel. The Thai Binh Cement Plant placed a 3,000- to 5,000-ton-per-year white cement production shop into operation, apparently also gas fired.

Shakedown problems, most of which were related to early startups before all the supporting and shortage facilities were completed, were being encountered in some of the plants.[89]

Petroleum.—Activity in the petroleum sector continued to increase and entered a new stage in 1988. The Government oil company, Vietnamese National Oil and Gas Co. (Petrovietnam), signed an exploration and production contract with British Petroleum Development Ltd. (BP) making the fourth such agreement since the Law on Foreign Investment was adopted by the National Assembly in December 1987. Under the contract, BP furnished all capital needed and assumed all risks during the surveying and exploration drilling in a 15,000-square-kilometer area off the coast of Da Nang in central Vietnam.

Hydrocarbons India Ltd. (HIL), a subsidiary of an Indian Government-owned oil company, signed the first production-sharing contract under the Foreign Investment Law in June 1988. HIL was to survey 6,000 line kilometers and drill two wells over 4 years in a 14,000-square-kilometer area along the southern continental shelf.

The first Western company to sign a contract was a consortium of Shell Exploration B.V. and the Belgian firm Petrofina S.A. Shell was to conduct 10,000 line kilometers of seismic survey in a 15,000-square-kilometer concession off the coast near Hue, north of the BP block.

The French petroleum company Total was the third company to sign an exploration contract during the year. Contract conditions were similar to the others. Its exploration block was in the northern Gulf of Tonkin.

TABLE 25

VIETNAM: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal destinations, 1987
METALS			
Aluminum: Metal including alloys, all forms	17	—	
Chromium: Ore and concentrate	198	2,122	All to Japan.
Copper: Metal including alloys, all forms	1,185	—	
Iron and steel: Metal:			
Scrap	87,031	84,582	Do.
Semimanufactures	2,068	NA	
Lead: Metal including alloys, unwrought	—	103	All to Italy.
Tin: Metal including alloys, unwrought	70	35	All to Hong Kong.
INDUSTRIAL MINERALS			
Feldspar, fluorspar, related materials	42	—	
Mica: Crude including splittings and waste	—	29	All to Japan.
Precious and semiprecious stones other than diamond: Natural value, thousands	$42	—	
Salt and brine	310	610	All to Hong Kong.
Stone, sand and gravel: Dimension stone, all forms	1,433	NA	
MINERAL FUELS AND RELATED MATERIALS			
Coal: Anthracite and bituminous	131,093	86,743	Japan 80,315; Thailand 4,180; Hong Kong 2,248.
Petroleum: Crude 42-gallon barrels	—	1,745,941	All to Japan.

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Vietnam, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any imports of mineral commodities from Vietnam during 1987.

TABLE 26

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS			
Alkali and alkaline-earth metals	—	2	All from Italy.
Aluminum: Metal including alloys, all forms	1,216	62	Japan 55; Belgium-Luxembourg 5.
Arsenic: Oxides and acids	—	1	All from Hong Kong.
Chromium: Oxides and hydroxides	22	91	Japan 89; Hong Kong 2.
Cobalt: Oxides and hydroxides	13	5	All from Japan.
Copper: Metal including alloys, all forms	522	19	Japan 17; Hong Kong 2.
Iron and steel: Metal:			
Ferroalloys	483	470	All from Japan.
Steel, primary forms	9	—	
Semimanufactures:			
Bars, rods, angles, shapes, sections	10,616	2,836	Japan 1,531; Hong Kong 1,199; Finland 101.
Universals, plates, sheets	9,655	6,253	Japan 3,816; Hong Kong 1,892; Australia 500.
Hoop and strip	588	213	Japan 195; Australia 11.
Rails and accessories	23	—	
Wire	1,028	406	Japan 365; Finland 20.
Tubes, pipes, fittings	11,670	2,049	Japan 1,758; Finland 248.
Castings and forgings, rough	—	2	All from Netherlands.
Lead:			
Oxides	20	30	All from Japan.
Metal including alloys, all forms	54	12	Do.
Manganese: Oxides	194	750	Japan 520; Hong Kong 230.
Mercury: 76-pound flasks	—	58	All from Japan.
Nickel: Metal including alloys, all forms	7	11	Do.
Silver: Metal including alloys, unwrought and partly wrought: value, thousands	$93	$11	Do.
Titanium: Oxides	463	263	Japan 215; Hong Kong 48.
Tungsten: Metal including alloys, all forms: kilograms	52	—	
Zinc:			
Oxides	586	191	Japan 139; Hong Kong 52.
Metal including alloys:			
Unwrought	300	188	All from Japan.
Semimanufactures	—	1	Do.
Other: Base metals including alloys, all forms	—	1	Do.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	89	21	All from Netherlands.
Artificial: Corundum	31	—	
Grinding and polishing wheels and stones	3	1	All from Japan.
Asbestos, crude	105	—	

See footnotes at end of table

TABLE 26—Continued

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
INDUSTRIAL MINERALS—Continued				
Cement		3,765	62,277	Thailand 41,900; Philippines 11,900; Hong Kong 8,477.
Clays, crude		1,096	—	
Cryolite and chiolite		—	5	All from Japan.
Diatomite and other infusorial earth		60	—	
Fertilizer materials: Manufactured:				
Ammonia		13	10	Do.
Nitrogenous		365,273	98,814	Indonesia 98,804.
Phosphatic		10,000	5,825	Philippines 5,800.
Potassic		81,603	—	
Unspecified and mixed		366	2	All from Belgium-Luxembourg.
Gypsum and plaster		1	—	
Magnesium compounds: Oxides and hydroxides		20	20	All from Hong Kong.
Mica: Worked including agglomerated splittings		3	1	All from Japan.
Pigments, mineral: Iron oxides and hydroxides, processed		76	15	Japan 11; Hong Kong 4.
Pyrite, unroasted		60,000	—	
Sodium compounds, n.e.s.:				
Carbonate, natural and manufactured		4,980	547	Japan 320; Hong Kong 227.
Sulfate, natural and manufactured		3,128	220	All from Hong Kong.
Stone, sand and gravel: Dimension stone, all forms		40	12	Italy 11; Japan 1.
Sulfur:				
Elemental, all forms		7,020	40	All from Japan.
Sulfuric acid		5	5	Do.
Talc, steatite, soapstone, pyrophyllite		2	96	Hong Kong 89; Japan 7.
Other: Metalloids, unspecified[2]		—	2	All from Hong Kong.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		—	1	All from Finland.
Carbon black		459	609	Japan 504; Hong Kong 105.
Coal: Anthracite and bituminous		36,044	38,149	All from Australia.
Coke and semicoke		2,400	—	
Petroleum refinery products:				
Gasoline	42-gallon barrels	—	51	All from Belgium-Luxembourg.
Mineral jelly and wax	do.	2,267	2,686	Hong Kong 2,560.
Kerosene and jet fuel	do.	19,656	1,000	All from Hong Kong.
Distillate fuel oil	do.	119	30	Do.
Lubricants	do.	39,242	73,941	Italy 73,052; Belgium-Luxembourg 525.
Bitumen and other residues	do.	3,531	61	All from Hong Kong.
Bituminous mixtures	do.	12	—	

[p] Preliminary.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Vietnam, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Vietnam during 1987.

[2] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

Vietnam's first petroleum refinery was completed in the fall and came on-stream December 15th. The 1,000-barrel-per-day topping plant, Saigon Petro Refinery, was in Thu Duc District on the southeast outskirts of Ho Chi Minh City. The Bach Ho Oilfield crude should yield 8% straight-run gasoline, 7% kerosene, and 27% diesel oil. The remaining heavy fraction would probably be exported for cracking and reforming into lighter products.

Construction continued on the 60,000-barrel-per-day Tuy Ha oil refinery between Vung Tau and Ho Chi Minh City. Completion was scheduled for the early 1990's.[90]

The joint-venture Soviet and Vietnamese oil company has proven to be the most successful industrial undertaking in the country. The company has discovered the Bach Ho Oilfield and two additional fields not yet in production. Bach Ho has produced over 7,200,000 barrels in 2½ years from five offshore platforms. Two additional platforms were being installed. Production was planned to increase to several times the 7-million-barrel level by 1990. If that production level was achieved, Vietnam would become self-sufficient in petroleum for the first time.

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[1] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Brunei dollars (B$) to U.S. dollars at the rate of B$2.20 = US$1.00.

[3] Petroleum Economist. V. 56, No. 2, Feb. 1989, p. 70.

[4] ———. V. 55, No. 6, June 1988, p. 213.

[5] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[6] Ministry of Planning and Finance. Report to the Pyithu Hluttaw on the Economic and Social Condition of the Socialist Republic of the Union of Burma for 1988-89. P. 122.

[7] The Burmese financial year begins Apr. 1 of the year stated.

[8] Where necessary, values have been converted from Burmese kyats (K) to U.S. dollars at the rate of K6.42 = US$1.00. The unofficial or black market rate is several to many times the official conversion rate and varied greatly depending on geographic location and time of year.

[9] Page 124 of work cited in footnote 6.

[10] TEX Report. V. 21, No. 4870, Mar. 2, 1989, p. 2.

[11] Tanjug (radio broadcast) in English. 1946 GMT, Mar. 22, 1988.

[12] Mining Journal (London). V. 311, No. 7985, Sept. 9, 1988, p. 5.

[13] U. S. Embassy, Rangoon, Burma. State Dep. Telegram R020538Z, Feb. 2 1989.

[14] Petroleum Economist. V. 55, No. 3, Mar. 1988, p. 96.

[15] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[16] Erlanger, S. The Endless War. The New York Times Magazine. Section 6, Mar. 1989, p. 24.

[17] The New York Times. Feb. 12, 1989, p. 25.

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